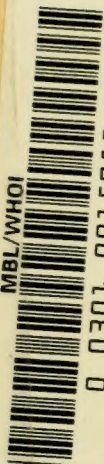




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ALCYONARIANS

AN ACCOUNT OF THE
ALCYONARIANS.

COLLECTED BY THE
ROYAL INDIAN MARINE SURVEY SHIP *INVESTIGATOR*
IN THE INDIAN OCEAN

BY

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WITH A REPORT ON THE SPECIES OF *DENDRONEPHTHYA* BY
W. D. HENDERSON, B.Sc., PH.D.

II. THE ALCYONARIANS OF THE LITTORAL AREA



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INTRODUCTION.

THIS memoir contains a description of a rich collection of Littoral Alcyonarians made by the Royal Indian Marine Survey Ship "Investigator" in the Indian Ocean.¹ It is a continuation of a previous memoir (Thomson and Henderson, 1906) dealing with the Deep-Sea forms.

The collection includes 187 species (sixty-one belonging to *Dendronephthya* or *Spongodes*); 108 are new, but fifty-three of these belong to *Dendronephthya* or *Spongodes* to which additions continue to be made in embarrassing numbers. It has been found necessary to establish four new genera,—*Studeriotés* appended to the Alcyoniidæ, *Dactylonephthya* appended to the Nephthyidæ, *Cactogorgia* among Siphonogorgiidæ, and *Parabelemnion* among the Veretillidæ.²

The following table will show the general nature of the collection and the distribution of the new forms :—

¹ I wish to thank the Trustees of the Indian Museum for giving me the opportunity of studying this fine collection of beautiful forms, and my thanks are also due to Professor A. Alcock, LL.D., F.R.S., formerly Superintendent of the Indian Museum, and to Dr. Nelson Annandale now Superintendent, for their kind assistance in connection with this prolonged and laborious investigation. Prof. Gilbert C. Bourne was good enough to send me a number of specimens belonging to the first "Investigator" collection and a report on these has been included. Through the Carnegie Trust I was able to secure the help of Mr. J. J. Simpson, joint author of this memoir, whose indefatigable work in this connection was done during his tenure of a Carnegie Scholarship and Fellowship. In the same way I have been able to include a report on the genus *Dendronephthya* or *Spongodes* by Dr. W. D. Henderson, who worked at the puzzling problem of its species during part of the time of his tenure of a Carnegie Fellowship. I have to thank the Carnegie Trustees also for a grant which has defrayed the expense of drawing four of the plates, and the expense of having zinc-blocks made for the text-illustrations. It would be ungrateful not to express indebtedness to the artist, Mr. George Davidson, for his skill and patience. The engraver, Mr. Edwin Wilson, also deserves to be congratulated on the success of his plates, for the coloured ones in particular presented difficulties which have been happily overcome.—J. A. T.

² Two of these genera have been previously reported and are here referred to as *Studeriotés* (= *Studeria*, Thomson) and *Cactogorgia*, Simpson. For the same reason all the numerous new species of *Dendronephthya* (or *Spongodes*) bear the name of Henderson.

Order.	Total Number of Genera in the Collection.	New Genera.	Total Number of Species in the Collection.	New Species.
I. Stolonifera	1	0	1	0
II. Alecyonacea	12	3	90	69
III. Pseudaxonia	5	0	11	3
IV. Axifera	22	0	51	23
V. Stelechotokea	10	1	34	13
Totals	50	4	187	108

New Types.

Studeriotēs is an Alecyoniid or a Nephthyid of very remarkable structure perhaps with distant affinities with *Paralecyonium*. It consists of a strong densely spiculate cup, within which very numerous finger-like polyp-bearing lobes or branches are retracted; these arise at different levels from a strong muscular central thalamus, and from the upper parts of the inner wall of the cup; each finger-like lobe is thickly covered with polyps and ends in one larger than the rest; the cavities of the polyps communicate with a central canal in the digitiform lobe, and these central canals unite in a few large longitudinal canals with large muscles on their walls and with few spicules; the polyps have a distinct non-retractile calyx covered with spindles arranged in double rows; the spicules are all warty spindles, except a few minute irregular forms found (along with sparse spindles) in the canal walls; many of the cortical spindles attain huge dimensions, some exceeding nine millimetres. In many respects this is a divergent form, highly differentiated in the direction of retractility of polyparium.

The genus *Cactogorgia*, defined in a separate publication, seems referable to a position in the sub-family Siphonogorginae. It differs from the *Siphonogorgia*-type in being even more densely spiculate and rigid, in showing a marked division into trunk and polyp-bearing portion, and in the absence of definite branching, the polyps being borne mainly on the margin of flattened lobes. The mode of growth is Cactus-like; the anthocodiae have a dense armature of "crown and points," and are completely retractile within distinct verrucae; the tentacles are simply infolded. The spicules of the stem and trunk are thick, warty spindles; those of the crown and points are spindles or clubs; those on the aboral surface of the tentacles are small, flat and scale-like.

The genus *Dactylonephthya* seems to occupy an intermediate position be-

tween Spongodinae, Siphonogorginae and Aleyniidae. In its large spindles it suggests *Sclerophytum*, but there are distinct polyp-calyces; in its stem, densely filled with spicules, it suggests some forms of *Siphonogorgia*, but it has no trace of a highly developed anthocodial armature; among Spongodinae (Nephthyidae of Kükenthal) its nearest ally is perhaps *Capnella*, but the state of the canal-walls and their spiculation is quite different. The whole colony is hard and rigid, the interior being packed with long and thick spindles. A short stalk gives off a few almost vertical branches bearing digitiform lobes covered with polyps. There are low, dome-like polyp-calyces, showing inturned tentacles, and an octoradiate aperture. The canal walls are thin and bear large spindles. The superficial coenenchyma contains abundant small, club-shaped spicules, sometimes approaching the foliated type (as in *Capnella*), and a few spindles; but all these superficial spicules are very small in comparison with the massive spindles in the interior.

The new genus *Parabelemnion* is proposed for a Veretillid, allied to *Stylobelemnion*, Kölliker, and *Stylobelemnoides*, Thomson and Henderson. It is quite probable that with the collection of more material, the apartness of these three forms will be lessened, and that some readjustment will be feasible, such as we have proposed in merging *Sclerobelemnion* with *Kophobelemnion*, but in the meantime the form for which we have proposed the new genus *Parabelemnion* seems to us to have a distinctive generic position. It is an elongated (190 mm.) and cylindrical Veretillid, with the rachis longer than the stalk. The autozooids are distributed over the surface, the interstices are covered with siphonozooids leaving no bare streak. The verrucæ are formed of long spicules in four groups ending in four triangular points. The quadrangular axis has a shallow groove on the para-rachidial surfaces. The spicules are abundant both in the rachis and in the cutis of the stalk, those of the stalk are rough scales, those in the rachis smooth spindles, cylinders and branched forms.

Some Characteristics of the Collection.

(a) When we compare this Littoral Collection with that previously described from the Deep Sea, we notice at once the large representation of certain genera, such as *Dendronephthya* or *Spongodes*, *Sclerophytum*, *Siphonogorgia*, *Melitodes*, *Pteröides*, and *Cavernularia*, and the absence of other genera, such as *Chrysogorgia* and *Umbellula*. Thus the peculiar series of *Sympodium* species, six of which were described in Part I., finds no representation here, but instead of two species of *Dendronephthya* we have here about sixty. There were six species of *Chrysogorgia* in the Deep Sea Collection, but there is none here; ten species of *Umbellula*, but none here; and the comparison might be pursued in detail. We shall give only one other illustration: the Deep Sea Collection

included four fine species of *Pennatula* and one accidentally included species of *Pteroëides* (from only 56 fathoms); the Littoral Collection has one accidentally introduced representative of *Pennatula* (from 609 fathoms), and sixteen species of *Pteroëides*.

(b) A glance at the collection as laid out on the shelves shows at once as the most conspicuous feature the large number of species (61) of *Dendronephthya* (or *Spongodes*) and the large number of these that we have had to label as new.

(c) To a lesser extent the same may be said in regard to *Siphonogorgia* and *Pteroëides*.

(d) The fine representation of Muriceids is noteworthy. Thus we have described six new species of *Echinomuricea*, three of *Echinogorgia*, two of *Acis*, two of *Muricella*, and two of *Eumuricea*.

(e) Perhaps the most characteristic feature is the representation of what we feel inclined to regard as annectent types related to Alcyonids, Nephthyids, and Siphonogorgids. We refer to the genera *Studeriotis*, *Dactylonephthya* and *Cactogorgia*.

Some Taxonomic Notes.

It seems to us that the species of *Dendronephthya* or *Spongodes* are in a state of flux. Some are sharply marked off from their neighbours, but most are separated by an ensemble of somewhat minute features. It may be that further investigation will enable us to group the species around centres, but the time for that has not yet come. It would be interesting to study some of the species statistically, but that would require to be done on the spot.

We have studied a large number of specimens which are referable to previously described species of *Siphonogorgia* and *Chironephthya*; we have given a fair trial to all the characters which have been advanced as distinctive of these two genera in contrast to one another, and we have found that none is satisfactory. We agree with Kükenthal that *Chironephthya* should be merged in *Siphonogorgia*.

In certain cases, such as *Stereacanthia* and *Cactogorgia*, it seems to us very difficult to decide between the sub-families Spongodinae and Siphonogorginae, but we have followed Bourne's characterisation of the Siphonogorginae as having "Canal walls densely filled with spicules". It seems to us that the contrast between the stem-canals in a type like *Eunephthya rosea* and in *Stereacanthia* is a useful criterion, though annectent forms like *Stereacanthia*, *Cactogorgia*, *Agaricoides* and *Dactylonephthya* help to bind Nephthyid and Siphonogorgid types together, and have led us to prefer Bourne's division of Nephthyidae into two sub-families Spongodinae and Siphonogorginae to Kükenthal's recognition of two families Nephthyidae and Siphonogorgiidae.

After a comparison of several specimens of *Keroëides* we have come to the

conclusion that *K. gracilis*, Whitelegge, and *K. pallida*, Hiles, should be included in the older species *K. koreni*, Wright and Studer.

The specimens of *Parisia* in this collection are more numerous and in better preservation than those in the Deep Sea Collection, and we have been led to merge *P. indica*, Thomson and Henderson, in *P. fruticosa*, Verrill.

We have suggested that *Acanthogorgia spinosa*, Hiles, should be merged in *A. muricata*, Verrill, and that *A. aspera*, Pourtales (somewhat vaguely described), is not far off.

An attempt has been made to give greater definiteness to Verrill's genus *Anthogorgia*, to which two new species are referred. It seems to us, however, that Studer's *A. japonica*, with an operculum *tentacular* and not *calycine*, cannot be included in this genus.

In connection with the genus *Muricella*, we have proposed an emended diagnosis and have taken a comparative survey of the well-defined species known to us at the time of writing. Acquaintance with transitional forms has led us to merge *M. ceylonensis*, Thomson and Henderson, with *M. ramosa*, Thomson and Henderson.

In describing *Menacella gracilis*, n. sp., we have sought to rehabilitate Gray's genus, adding some more content to his definition and slightly enlarging it.

A study of a number of difficult transitional forms of *Bebryce* has led us to suggest that *B. studeri*, Whitelegge, and *B. philippi*, Studer, should be merged in *B. mollis*, Philippi.

A consideration of *Kophobelemnion intermedium*, n. sp., and *K. burgeri*, Herklots, in relation to species of *Sclerobelemnion* has led us to the conclusion that the two species named bind *Kophobelemnion* and *Sclerobelemnion* so closely together that the latter should be merged in the former. It does not seem to us that there is any generic contrast, and we have given an emended diagnosis of *Kophobelemnion* to include our new annectent species and *Sclerobelemnion* as well.

Some of the specimens which we have referred to *Cavernularia obesa*, Val., seem to us to show that Studer's *C. madeirensis* should be included in the same species. Similarly, the advantage of having a considerable number of specimens was seen in the case of *C. lütkenii*, Köll., for it became plain that this species must include Moroff's *C. habereri*. In other words, there is no discontinuity that we can perceive between *C. obesa* and *C. madeirensis*, or between *C. lütkenii* and *C. habereri*.

The study of those beautiful and interesting colonies which we have named as *Lituaria hicksoni*, n. sp., has led us to propose a somewhat enlarged diagnosis of the genus.

Geographical Distribution.

The only general result as regards geographical distribution of species is that a large number are common to the Indian Ocean and to such localities in the Pacific Ocean as Borneo, Sumatra, Java, Sulu Sea, Arafura Sea, Banda, Japan, Formosa, Torres Strait and North West Australia.

Species which have been previously recorded from the Pacific Ocean :—

- Sarcophytum plicatum*, Schenk (Ternate).
Sarcophytum ehrenbergi, Marenzeller (New Guinea).
Lobophytum crassum, Marenzeller (Australia).
Sclerophytum polydactylum (Pratt), (New Guinea).
Sclerophytum densum (Pratt), (Funafuti), (New Guinea).
Siphonogorgia mirabilis, Klunzinger (New Hebrides).
Siphonogorgia macrospina, Whitelegge (Funafuti).
Solenocaulon tortuosum, Gray (Australia).
Solenocaulon sterroklonium, Germanos (Ternate).
Suberogorgia köllikeri, Wright and Studer (Japan).
Suberogorgia verriculata, Esper (Japan, Australia).
Keroeides koreni, Wright and Studer (Japan ; Funafuti, as *K. gracilis* ; New Britain, as *K. pallida*).
Melitodes philippinensis, Wright and Studer (Philippines).
Parisis fruticosa, Verrill (West Coast of Australia, Formosa, Sulu Sea, Banda).
Isis hippuris, Linnæus (Straits of Sunda, Sumatra, East Indies, Amboina).
Acanthogorgia muricata, Verrill (New Britain, Australia).
Echinogorgia flabellum, Esper (Queensland).
Echinogorgia pseudosasappo, Kölliker (Torres Strait).
Echinogorgia ramulosa, Gray (Philippines).
Echinogorgia intermedia, Studer (N.W. Australia).
Bebryce mollis, Philippi (Arafura Sea, as *B. philippi*, Studer ; Funafuti, as *B. studeri*, Whitelegge).
Acis pustulata, Wright and Studer (Japan).
Elasmogorgia filiformis, Wright and Studer (Arafura Sea).
Muricella complanata, Wright and Studer (Japan).
Plexauroides praelonga (Ridley), (Australia).
Telesto arborea, Wright and Studer (Arafura Sea).
Virgularia juncea, Pallas (Borneo, Philippines).
Pteroëides lacazii, Kölliker (Sumatra, Australia).
Pteroëides multiradiatum, Kölliker (Penang).
Pteroëides flavidum, Kölliker (Java).
Pteroëides crassum, Kölliker (Singapore).
Pteroëides hymenocaulon, Bleeker (Amboina).

Pteroëides steenstrupii, Köl liker (Java)
Pteroëides esperi, Herklots (Java, Philippines, Sumatra).
Cavernularia obesa, Valenciennes (Penang).
Cavernularia elegans, Herklots (Japan).
Lituaria phalloides (Pallas), (Amboina, Sumatra, Penang).
Policella australis, Gray (Australia).

The collection includes a number of species which have been previously recorded from the Indian Ocean, *e.g.*—

Tubipora chamissonis, Ehrenberg.
 * *Sarcophytum ehrenbergi*, Marenzeller.
Sclerophytum hirtum, Pratt.
 * *Sclerophytum polydactylum* (Pratt), (Maldives).
 * *Sclerophytum densum* (Pratt), (Maldives).
Sclerophytum querciforme (Pratt), (Maldives).
 * *Siphonogorgia variabilis* (Hickson), (Maldives, Ceylon).
Siphonogorgia macrospiculata (Thomson and Henderson).
 * *Siphonogorgia mirabilis*, Klunzinger (Red Sea).
 * *Solenocaulon tortuosum*, Gray (Maldives).
 * *Suberogorgia kôllikeri*, Wright and Studer (Ceylon, Zanzibar).
 * *Keroëides koreni*, Wright and Studer (Andamans, as *K. koreni* and as *K. gracilis*).
Melitodes variabilis, Hickson (Maldives).
 * *Parisis fruticosa*, Verrill (Andamans, Gulf of Martaban).
Caligorgia indica, Thomson and Henderson (Andamans).
 * *Isis hippuris*, Linnæus, "Indian Ocean".
Calicogorgia investigatoris, Thomson and Henderson.
 * *Echinogorgia flabellum*, Esper (Andamans).
 * *Echinogorgia pseudosasappo*, Köl liker (Andamans, Ceylon).
 * *Echinogorgia ramulosa*, Gray (Andamans, Persian Gulf).
 * *Echinogorgia intermedia*, Studer (Andamans, Arakan Coast).
Echinogorgia multispinosa, Thomson and Henderson (Ceylon, Andamans, Coromandel Coast).
Acamptogorgia bebycoides (Koch), (Mediterranean).
Acamptogorgia rubra, Thomson (Ceylon).
Acamptogorgia ceylonensis, Thomson and Henderson (Ceylon).
Acis ceylonensis, Thomson and Henderson (Ceylon, Andamans, Ganjam Coast).
Acis indica, Thomson and Henderson (Ceylon).
Elasmogorgia flexilis, Hickson (Maldives).
 * *Muricella complanata*, Wright and Studer (Ceylon, Bay of Bengal).

* Those marked with an asterisk occur also in the Pacific.

Muricella ramosa, Thomson and Henderson (Ceylon, Bay of Bengal, Persian Gulf).

Muricella rubra, Thomson (Ceylon, Bay of Bengal).

Plexaura indica, Ridley (Mergui).

Lophogorgia lutkeni, Wright and Studer (Ceylon).

* *Telesto arborea*, Wright and Studer (Zanzibar).

Telesto rubra, Hickson (Maldives, Ceylon).

Telesto trichostemma, Dana (Ceylon).

Virgularia elegans, Gray (Ceylon).

* *Virgularia juncea*, Pallas.

Pterœides macandrewi, Kölliker (Gulf of Suez).

* *Cavernularia obesa*, Valenciennes (Bay of Bengal, Ceylon).

Cavernularia lütkenii, Kölliker (Bay of Bengal).

* Those marked with an asterisk occur also in the Pacific.

LIST OF SPECIES.

ORDER I. STOLONIFERA, Hickson.

Family TUBIPORIDÆ—

<i>Tubipora chamissonis</i> , Ehrenberg	1
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ORDER II. ALCYONACEA, Verrill (*pro parte*).

Family ALCYONIDÆ—

(a) Monomorphic :

<i>Alcyonium klunzingeri</i> , n. sp.	2
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(β) Dimorphic :

<i>Sarcophytum plicatum</i> , Schenk	3
„ <i>ehrenbergi</i> , Marenzeller	4
<i>Lobophytum crassum</i> , Marenzeller	4
<i>Sclerophytum hirtum</i> , Pratt	5
„ <i>polydactylum</i> (Pratt) (= <i>Lobularia polydactyla</i> , Ehrenberg)	5
„ <i>densum</i> (Pratt) (= <i>Lobophytum densum</i> , Whitelegge)	6
„ <i>querciforme</i> , Pratt	6
„ <i>andamanense</i> , n. sp.	7

Incertæ sedis, appended in the meantime to Alcyonidæ—

<i>Studeriotis mirabilis</i> , g. et sp. n.	8
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Family NEPHTHYIDÆ—

Sub-family Spongodinæ :

<i>Nephthya glomerata</i> , n. sp.	15
„ <i>tenuispina</i> , n. sp.	17
<i>Dendronephthya</i> , Kükenthal (syn. <i>Spongodes</i>)	18

Division Glomeratæ :

<i>Dendronephthya irregularis</i> , Henderson	18
„ <i>ovata</i> , Henderson	20
„ <i>köllickeri</i> , var. <i>andamanensis</i> , Henderson	22
„ <i>colombiensis</i> , Henderson	23

Division Divaricatæ :

<i>Dendronephthya cocosiensis</i> , Henderson	26
„ <i>purpurea</i> , Henderson	27
„ <i>cervicornis</i> , Wright and Studer	29
„ <i>orientalis</i> , Henderson	30
„ <i>arbuscula</i> , Henderson	32
„ <i>costatorubra</i> , Henderson	34
„ <i>macrocaulis</i> , Henderson	36
„ <i>andersoni</i> , Henderson	38
„ <i>translucens</i> , Henderson	39

Family *NEPHTHYIDÆ*—Division *Divaricatæ* (*continued*)—

<i>Dendronephthya masoni</i> , Henderson	.	.	.	.	.	40
„ <i>padavensis</i> , Henderson	.	.	.	.	.	42
„ <i>parvula</i> , Henderson	.	.	.	.	.	44
„ <i>divaricata</i> , Gray	.	.	.	.	.	45
„ <i>thuja</i> , Henderson	.	.	.	.	.	46
„ <i>rigida</i> , Studer	.	.	.	.	.	47
„ <i>microspiculata</i> , Pütter	.	.	.	.	.	47
„ „ „ var. <i>andamanensis</i> , Henderson	.	.	.	.	.	47
„ <i>mirabilis</i> , Henderson, nec. <i>S. mirabilis</i> , May	.	.	.	.	.	49
„ <i>foliata</i> , Henderson	.	.	.	.	.	51
„ <i>pentagona</i> , Henderson	.	.	.	.	.	53
„ <i>merguiensis</i> , Henderson	.	.	.	.	.	55
„ <i>crystallina</i> , Henderson	.	.	.	.	.	56
„ <i>andamanensis</i> , Henderson	.	.	.	.	.	58
„ <i>persica</i> , Henderson	.	.	.	.	.	60
„ <i>dichotoma</i> , Henderson	.	.	.	.	.	62
„ <i>ganjamensis</i> , Henderson	.	.	.	.	.	64
„ <i>longispina</i> , Henderson	.	.	.	.	.	66
„ <i>arakanensis</i> , Henderson	.	.	.	.	.	69
„ <i>delicatissima</i> , Henderson	.	.	.	.	.	70

Division *Umbellatæ*:

<i>Dendronephthya umbellulifera</i> , Kükenthal	.	.	.	.	.	71
„ <i>pallida</i> , Henderson, nec. <i>S. pallida</i> , Holm	.	.	.	.	.	73
„ <i>obtusa</i> , Henderson	.	.	.	.	.	74
„ <i>grandiflora</i> , Henderson	.	.	.	.	.	76
„ <i>conica</i> , Henderson	.	.	.	.	.	78
„ <i>multispinosa</i> , Henderson	.	.	.	.	.	80
„ <i>gilva</i> , Henderson	.	.	.	.	.	82
„ <i>brevirama</i> , Burchardt, var. <i>andamanensis</i> , Henderson	.	.	.	.	.	84
„ <i>elegans</i> , Henderson	.	.	.	.	.	85
„ <i>gregoriensis</i> , Henderson	.	.	.	.	.	87
„ <i>tripartita</i> , Henderson	.	.	.	.	.	88
„ <i>brachycaulos</i> , Henderson	.	.	.	.	.	90
„ <i>pellucida</i> , Henderson	.	.	.	.	.	92
„ <i>varicolor</i> , Henderson	.	.	.	.	.	93
„ <i>variata</i> , Henderson	.	.	.	.	.	95
„ <i>harrisoni</i> , Henderson	.	.	.	.	.	96
„ <i>booleyi</i> , Henderson	.	.	.	.	.	98
„ <i>albogilva</i> , Henderson	.	.	.	.	.	100
„ <i>lanxifera</i> , Holm	.	.	.	.	.	102
„ „ „ var. <i>palkensis</i> , Henderson	.	.	.	.	.	103
„ „ „ „ <i>andamanensis</i> , Henderson	.	.	.	.	.	104
„ <i>inermis</i> , Henderson	.	.	.	.	.	105
„ <i>quadrata</i> , Henderson	.	.	.	.	.	107
„ <i>ochracea</i> , Henderson	.	.	.	.	.	108
„ <i>nicobarensis</i> , Henderson	.	.	.	.	.	110
„ <i>rubeola</i> , Henderson	.	.	.	.	.	111
„ <i>agaricoides</i> , Henderson	.	.	.	.	.	113
„ <i>malabarensis</i> , Henderson	.	.	.	.	.	114
„ <i>decipiens</i> , Henderson	.	.	.	.	.	116
„ <i>ambigua</i> , Henderson	.	.	.	.	.	117

Family *NEPHTHYIDÆ*—Division Umbellatæ—(continued)—

<i>Dendronephthya elongata</i> , Henderson	. . . . .	xv, xvii, 119
„ sp. (?)	. . . . .	120
„ sp. (?)	. . . . .	121
„ sp. (?)	. . . . .	121

Sub-family Siphonogorginæ :

<i>Siphonogorgia variabilis</i> (= <i>Chironephthya variabilis</i> , Hickson)	. . . . .	125
„ <i>macrospiculata</i> (= <i>C. macrospiculata</i> , Thomson and Henderson)	. . . . .	128
„ <i>mirabilis</i> , Klunzinger (= <i>S. pustulosa</i> , Studer)	. . . . .	129
„ <i>macrospina</i> , Whitelegge	. . . . .	131
„ <i>rotunda</i> , Harrison	. . . . .	132
„ <i>media</i> , n. sp.	. . . . .	132
„ <i>palmata</i> , n. sp.	. . . . .	133
„ <i>annectens</i> , n. sp.	. . . . .	134
„ <i>asperula</i> , n. sp.	. . . . .	136
„ <i>duriuscula</i> , n. sp.	. . . . .	137
<i>Scleronephthya flexilis</i> , n. sp.	. . . . .	139
<i>Stereacanthia indica</i> , Thomson and Henderson	. . . . .	140
„ <i>armata</i> , n. sp.	. . . . .	141
<i>Cactogorgia celosioides</i> , Simpson	. . . . .	145
„ <i>expansa</i> , Simpson	. . . . .	147
„ <i>alciformis</i> , Simpson	. . . . .	148
<i>Incertæ sedis</i> , appended in the meantime to <i>Nephtyidæ</i>	. . . . .	150
<i>Dactylonephthya granulata</i> , n. gen. et sp.	. . . . .	151

ORDER III. PSEUDAXONIA, G. von Koch.

Family *BRIAREIDÆ*—

Sub-family Briareinæ :

<i>Solenocaulon tortuosum</i> , Gray	. . . . .	154
„ <i>sterroklonium</i> , Germanos	. . . . .	157

Family *SCLEROGORGIDÆ*—

<i>Suberogorgia köllikeri</i> , var. <i>ceylonensis</i> , Thomson	. . . . .	164
„ <i>verriculata</i> , Esper	. . . . .	164
„ <i>ornata</i> , n. sp.	. . . . .	164
<i>Keroeides koreni</i> , Wright and Studer	. . . . .	167

Family *MELITODIDÆ*—

<i>Melitodes variabilis</i> , Hickson	. . . . .	169
„ <i>philippinensis</i> , Wright and Studer	. . . . .	172
„ <i>ornata</i> , n. sp.	. . . . .	173
„ <i>pulchella</i> , n. sp.	. . . . .	175
<i>Parisis fruticosa</i> , Verrill (= <i>Parisis indica</i> , Thomson and Henderson)	. . . . .	176

ORDER IV. AXIFERA, G. von Koch.

Family *PRIMNOIDÆ*—

Sub-family Primnoinæ :

<i>Caligorgia indica</i> , Thomson and Henderson	180
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Family *ISIDÆ*—

Sub-family Isidinæ :

<i>Isis hippuris</i> , Linnæus	180
--	-----

Family *MURICEIDÆ*—

<i>Acanthogorgia muricata</i> , Verrill	192
<i>Anthogorgia glomerata</i> , n. sp.	194
„ <i>racemosa</i> , n. sp.	195
<i>Calicogorgia investigatoris</i> , Thomson and Henderson	196
„ <i>tenuis</i> , n. sp.	197
<i>Echinomuricea uliginosa</i> , n. sp.	201
„ <i>andamanensis</i> , n. sp.	203
„ <i>indica</i> , n. sp.	204
„ <i>ochracea</i> , n. sp.	205
„ <i>reticulata</i> , n. sp.	206
„ <i>splendens</i> , n. sp.	207
<i>Echinogorgia flabellum</i> , Esper	212
„ <i>pseudosassapo</i> , Kölliker	213
„ <i>ramulosa</i> , Gray	215
„ <i>intermedia</i> , Studer	217
„ <i>multispinosa</i> , Thomson and Henderson	218
„ <i>macrospiculata</i> , n. sp.	219
„ <i>flexilis</i> , n. sp.	220
<i>Menacella gracilis</i> , n. sp.	221
<i>Bebryce mollis</i> , de Philippi	225
„ <i>tenuis</i> , n. sp.	228
<i>Acamptogorgia bebrycoides</i> , G. von Koch	229
„ <i>rubra</i> , Thomson	229
„ <i>ceylonensis</i> , Thomson and Henderson	230
„ <i>tenuis</i> , n. sp.	230
<i>Acis ceylonensis</i> , Thomson and Henderson	232
„ <i>indica</i> , Thomson and Henderson	233
„ <i>pustulata</i> , Wright and Studer	234
„ <i>ulex</i> , n. sp.	236
„ <i>rigida</i> , n. sp.	237
<i>Elasmogorgia filiformis</i> , Wright and Studer	238
„ <i>flexilis</i> , Hickson	240
<i>Muricella complanata</i> , Wright and Studer	250
„ <i>ramosa</i> , Thomson and Henderson	252
„ <i>rubra</i> , Thomson	253
„ „ „ var. <i>robusta</i> , n.	255
„ <i>arborea</i> , n. sp.	255
„ <i>robusta</i> , n. sp.	257
<i>Eumuricea splendens</i> , n. sp.	258
„ <i>ramosa</i> , n. sp.	260

Family *PLEXAURIDÆ*—

<i>Plexaura indica</i> , Ridley	261
<i>Plexauroides praelonga</i> (Ridley) (= <i>Plexaura praelonga</i> , Ridley)	262
<i>Psammogorgia ridleyi</i> , n. sp.	263

Family *GORGONIDÆ*—

<i>Lophogorgia lutkeni</i> , Wright and Studer	264
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Family *GORGONELLIDÆ*—

<i>Nicella reticulata</i> , n. sp.	266
„ <i>pustulosa</i> , n. sp.	267
<i>Juncella racemosa</i> , Wright and Studer	268
<i>Verrucella flexuosa</i> , Klunzinger	269
<i>Gorgonella umbella</i> , Esper	272
„ <i>granulata</i> , Esper	274

ORDER V. STELECHOTOKEA, Bourne.

SECTION I.—ASIPHONACEA.

Family *TELESTIDÆ*—

<i>Telesto arborea</i> , Wright and Studer	276
„ <i>rubra</i> , Hickson	277
„ <i>trichostemma</i> , Dana	277

SECTION II.—PENNATULACEA.

Family *KOPHOBELEMNONIDÆ*—

<i>Kophobelemnon intermedium</i> , n. sp.	277
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Family *VIRGULARIDÆ*—

Sub-family Virgularinæ :

<i>Virgularia elegans</i> , Gray	280
„ <i>juncea</i> , Pallas	280
„ <i>ornata</i> , n. sp.	281
„ <i>fusca</i> , n. sp.	281
„ sp. (?)	282
<i>Scytalium martensii</i> , K��lliker	282
„ „ „ var. <i>magniflora</i> , n.	283

Family *PENNATULIDÆ*—

Sub-family Pennatulina   :

<i>Pennatula indica</i> , Thomson and Henderson	285
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Sub-family Pteroeidid   :

<i>Pteroeides nigrum</i> , K��lliker	286
„ <i>lacazii</i> , var. <i>spinosum</i> , K��lliker	287
„ <i>ilicifolium</i> , n. sp.	288
„ <i>multiradiatum</i> , K��lliker	289
„ <i>intermedium</i> , n. sp.	290
„ <i>griseum</i> , K��lliker	291
„ <i>robustum</i> , n. sp.	292
„ <i>mac-andrewi</i> , K��lliker	293
„ <i>andamanense</i> , n. sp.	294
„ <i>indicum</i> , n. sp.	295
„ <i>punctatum</i> , n. sp.	296
„ <i>flavidum</i> , K��lliker	297

DESCRIPTION OF SPECIES.



ORDER I. STOLONIFERA, Hickson.

Family *TUBIPORIDÆ*.

GENUS TUBIPORA, Linnæus.

Tubipora chamissonis, Ehrenberg.

It is a matter of considerable difficulty to refer a specimen of this genus to any one of the described species owing to the fact that the specific characters given for many are far from constant. We refer a single specimen in this collection to Ehrenberg's original species (= *T. musica*, Cham.).

It is a large fragment, 105 mm. in length and 30 mm. in breadth, of a bright coral-red colour. The diameter of the zooid-tubes is far from uniform, but 2.25 mm. is an average measurement. The tubes are separated by intervals of 1.3 mm. The lamellæ are about 1 mm. in thickness and are from 2 to 3.25 mm. apart.

Locality: N. Maldivé Atoll.

Previously recorded from N. Maldivé Atoll, Zanzibar, Red Sea, New Britain, etc.

ORDER II. ALCYONACEA, Verrill (*pro parte*).

Family ALCYONIDÆ.

(α) *Monomorphic*.

Alcyonium klunzingeri, n. sp.

(β) *Dimorphic*.

Sarcophytum plicatum, Schenk.

„ *ehrenbergi*, Marenzeller.

Lobophytum crassum, Marenzeller.

Sclerophytum hirtum, Pratt.

„ *polydactylum*, Pratt (= *Lobularia polydactyla*, Ehrenberg).

„ *densum*, Pratt (= *Lobophytum densum*, Whitelegge).

„ *querciforme*, Pratt.

„ *andamanense*, n. sp.

Incertæ sedis:—*Studeriotis mirabilis*, Thomson.

GENUS ALCYONIUM, Linnæus.

Alcyonium klunzingeri, n. sp.

Two exquisite and distinctive colonies, one of a cream colour, the other pink with just a hint of purple. Both are of an encrusting nature and have been attached to rocks, so that the general basal contour is irregular. The basal portion of the larger is 65 mm. long and 60 mm. in breadth; similar measurements in the other are 65 mm. and 50 mm. In neither does the height exceed 25 mm.



Fig. 1. *Alcyonium klunzingeri*, n. sp.
—A general view of a piece of a colony, natural size.

small spicules. The cœenchymal canals are cylindrical and very distinct;

those near the margin are much larger than those in the interior, but they eventually taper and unite with the more central canals.

The polyps occur all over the basal plate and lobes and are very regularly arranged so that the coenenchyma forms a sort of reticulate structure. The openings are circular but sometimes appear as small octagons when magnified. The anthocodæ are completely retractile. They withdraw themselves until they are within the surface of the coenenchyma where they appear as octagonal figures formed by the inturning of the tentacles. The regular network which separates the polyps does not contract so as to cover the anthocodæ. The polyp openings are about 1 mm. in diameter and the walls about 0.5 mm. in diameter. They are arranged somewhat regularly in rows which in most cases alternate.

Locality : Gt. Coco Island, Andamans.

GENUS SARCOPHYTUM, Lesson.

Sarcophytum plicatum, Schenk.

To this species we refer two colonies, one very large and much convoluted, the other small, mushroom-shaped and regular. The larger is attached to a calcareous nullipore and has a basal attachment 50 mm. long and 20 mm. in maximum breadth. The whole colony is about 40 mm. in height and has been primarily reniform, but by secondary convolutions this scheme is partly obliterated; the margin is very irregular. The texture is "leathery" or may even approach to "hard". The coenenchymal canals are circular and very definite throughout the colony.

The autozooids are fairly large and distant but are much more crowded towards the periphery and on the marginal convexity; they give the colony a downy appearance when exserted. Eight or nine occur in 1 cm. in rather definite rows; the openings appear as small pores when the anthocodæ are retracted. The siphonozooids are hardly perceptible.

The smaller colony is mushroom-shaped and has a sterile stalk 13 mm. long and 12 mm. in diameter; this is surmounted by an expanded disc about 24 mm. in diameter. The thickness of the central part of the capitulum is about 5 mm. but it tends to become wedge-shaped towards the margin. Convolutions are still absent. In this specimen the autozooids are larger and the pores more distinct; the latter are about 1 mm. in diameter. The siphonozooids appear to the naked eye as dark minute dots.

The colour of the larger colony is purplish, that of the smaller brown.

This species is described in detail by Schenk (1896), p. 76, Tafel II. fig. 12, Tafel IV. fig. 40.

Locality : Mergui and Andamans.

Previously recorded from Ternate.

Sarcophytum ehrenbergi, Marenzeller.

To this species we refer a small colony 25 mm. in height with a sterile stalk, 15 mm. long and 9 mm. in diameter, surmounted by an expanded disc, giving a distinct mushroom shape. The capitulum is saucer-shaped; the margin is turned up slightly instead of down as is usually the case. The texture of the colony is leathery, but the spicules are numerous near the surface.

The autozooids are large and distant; some are about 4 mm. in length and are separated by distances of from 2 mm. to 3.5 mm. They are more closely packed around the margin. The siphonozooids are large and fairly abundant.

The colour of the colony, as recorded at the time of preservation, was a pale dirty chocolate with black autozooids.

This species was first described by Marenzeller (1886), p. 356 (Tafel IX. figs. 3 and 4), and again in detail by Miss Pratt (1903), p. 508 (Plate XXVIII. figs. 1 and 2).

Locality: Andamans.

Previously recorded from Red Sea, Port Denison (Australia), Viti Islands, China Straits (New Guinea), Maldives.

GENUS LOBOPHYTUM, Marenzeller.

Lobophytum crassum, Marenzeller.

To this species as defined by Marenzeller (1886, p. 363, Tafel IX. figs. 8, 9, 10 and 11), we refer a small young colony somewhat mushroom-shaped. It consists of a sterile stalk 20 mm. in length and 5.5 mm. in diameter at the base, but gradually increasing to 10 mm. at the top, where it is surmounted by a much-convoluted capitulum. The whole colony is hard and rigid and is abundantly supplied with small spicules. The coenenchymal canals are large and distinct; they are cylindrical almost to the base of the colony.

The autozooids are small and have minute pores. They are very distant and are separated by intervals of 2.5 mm. to 3.5 mm. The siphonozooids are minute and numerous; they are very crowded and give the colony a pitted appearance visible to the naked eye.

The colour is pale yellow to cream.

This is a very variable species. Marenzeller distinguishes four varieties: (1) *L. crassum* (type), from Port Denison; (2) *L. crassum*, var. *borbonicum*, from Island of Reunion; (3) *L. crassum*, var. *crista-galli*, from Tonga; and (4) *L. crassum*, var. *prolifera*, from Port Denison. Our specimen is young and immature so that we do not feel justified in ranking it under any distinct variety.

Locality: Pedro Shoal.

Previously recorded from Port Denison, Reunion, Tonga, Loyalty Islands.

GENUS *SCLEROPHYTUM*, Pratt.*Sclerophytum hirtum*, Pratt.

We assign to this species a colony which while differing considerably from the type species as described by Pratt (1903), p. 522, Pl. XXX. figs. 23-25, nevertheless agrees in all essential characters. There is practically no stalk visible; the colony is excessively convoluted, and the margin has become turned down so that it reaches to the place of attachment to the rock. The total height is 50 mm. while the two breadths are respectively 110 mm. and 75 mm. There cannot be said to be any distinct lobes; the colony is tough and fleshy.

The autozooids are regularly distributed over the whole colony at distances varying from 1 mm. to 1.5 mm.; when expanded they are about 1 mm. in diameter. The siphonozooids are very minute and are not visible to the naked eye.

The colour of the colony is almost olive-green.

Locality: N. Andaman Island.

Previously recorded from Naifaro Reef, Fadifolu Atoll, Maldives.

Sclerophytum polydactylum, Pratt.

(= *Alcyonium polydactylum*, Dana, "Zoophytes," p. 617.)

(= *Alcyonium polydactylum*, Klunzinger, "Die Korallthiere des Rothen Meeres," p. 26, Tafel I. figs. 6a to f.)

(= *Lobularia polydactyla*, Ehrenberg, "Korallthiere," p. 58.)

(= *Lobularia polydactyla*, Milne-Edwards and Haime, "Coralliaires," I. p. 121.)

(= *Ammocella polydactyla*, Gray, "Ann. Mag. Nat. Hist." p. 125, 1869.)

This species was included in the genus *Sclerophytum* for the first time by Miss Pratt ("Alcyonaria of the Maldives," 1903, p. 524). It is represented in the present collection by a portion of what has evidently been a large colony, but the base is wanting. The specimen is 50 mm. in height, 70 mm. in maximum breadth, and 20 mm. in thickness. The lower part does not bear polyps, but above this region irregular finger-shaped lobes arise, one of these again bearing secondary lobes.

The specimen is tough and fleshy, but the coenenchyma of the lower part bears numerous large spindles.

The autozooids are small; they are about 0.5 mm. in diameter and are separated by intervals of 1 to 1.25 mm. No trace of siphonozooids could be found.

The colour of the specimen is a pale chocolate.

Locality : Mergui.

Previously recorded from the Red Sea (Klunzinger and Ehrenberg), New Guinea (Hickson and Hiles), Maldives (Pratt).

Sclerophytum densum, Pratt.

(= *Lobophytum densum*, Whitelegge, "Alcyonaria of Funafuti," 1897, p. 219. Plate XI. figs. 4a to h.)

See Pratt, "Alcyonaria of the Maldives," 1903, p. 521. Plate XXIX. fig. 18; Plate XXX. figs. 20-22.

This species is represented by a portion of a colony, evidently a primary lobe, 60 mm. in height, 25 mm. in breadth, and 18 mm. in thickness at the base, but tapering almost conically to a diameter of 9 mm. where it divides into two finger-shaped processes. Just below this division two small lobes arise almost close together, each about 16 mm. in length and 7 mm. in diameter.

The cœnenchyma is densely packed with large opaque white spicules which make the colony very hard.

The autozooids are large and fairly numerous. Some are about 2 mm. in length and 1 mm. in diameter. They are separated by intervals of about 1 to 1.5 mm. in the lobes, but are more distant on the older portion. This agrees well with the description given by Whitelegge, but Miss Pratt says that the autozooids are "very numerous". The siphonozooids are almost imperceptible even with a strong lens.

There is a furrow about 3.5 mm. broad and 1.25 mm. deep along one side of the colony between the two lobes; this is devoid of autozooids.

The colour is almost jet black.

Locality : Andamans.

Previously recorded from Funafuti (Whitelegge), Addu Atoll, 11 fathoms; Hulule, Male Atoll, 25 fathoms; Felidu Atoll, 34 fathoms; Maldives (Pratt); Sandal Bay, Lifu (Pratt); China Straits, British New Guinea (Pratt).

Sclerophytum querciforme, Pratt.

To this species, defined by Pratt (1903), ("Alcyonaria of the Maldives," p. 530. Plate XXXI. fig. 33), we refer two very robust, arborescent colonies of an almost jet black colour. The larger colony is 80 mm. in height and 100 mm. in maximum breadth; the basal attachment is 45 mm. long and 35 mm. broad. The smaller is 45 mm. high and about the same in breadth; there is practically no stalk; the branches arise almost from the base; the lobes are finger-like.

In the larger specimen the main stem gives off several branches and these again bear secondary and sometimes tertiary lobes.

The surface is very rugged; the texture is leathery; the main stem is densely packed with large spicules.

The autozooids are numerous; they are separated by intervals of about 1 mm. and are about 0.5 mm. in diameter. Siphonozooids do not occur.

Locality: Andamans.

Previously recorded from Hulule, Male Atoll; Maldives (Pratt).

Sclerophytum andamanense, n. sp.

We reluctantly add to the already long list of species in this genus, but the characters of the present specimen, though approaching *S. tuberculosum* (*Lobophytum tuberculosum*, Quoy et Gaimard), mark it off as new.

The colony is low and spreading; the basal attachment is 55 mm. long and 25 mm. broad. The stalk is very indefinite; on one side of the basal plate it rises to a height of 22 mm. but it is altogether absent on the other side, so that the polyp-bearing capitulum extends to the very base. The margin of the capitulum is very much convoluted, especially on the side where the stalk is apparent. The colony may be said to be fleshy and tough, but there is an abundance of spicules in the stalk and central portion of the capitulum.

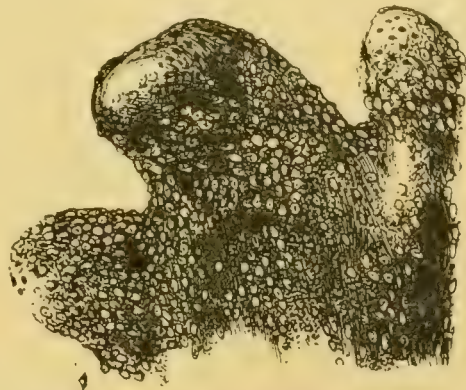


Fig. 2. *Sclerophytum andamanense*, n. sp.
—A general view of a piece of the colony, natural size.

The autozooids are large, and when expanded are over 2 mm. in length and 1 mm. in diameter; the tentacles are quite visible to the naked eye. When the polyps are partially retracted the tentacles are infolded and form a beautiful eight-rayed star. The orifices are 0.75 to 1 mm. in diameter; they are separated by distances varying from 1 to 2 mm., but at the margin they are more crowded, so that even when the autozooids are partially retracted and have the tentacles unfolded they almost touch.

The siphonozooids are extremely minute or altogether absent.

The colour of the colony is greenish-brown.

Locality: Andamans.

GENUS STUDERIOTES.

Studeriotēs mirabilis,¹ *n. nom.* (= *Studeria mirabilis*, Thomson).

The collection includes a specimen from the Andamans which is certainly one of the most remarkable of the many interesting representatives of this sub-class that have been discovered within recent years. It is a cup-like



Fig. 3. Longitudinal section of *Studeriotēs mirabilis*.—Natural size.



Fig. 4. The upper part of one of the digitiform polyp-bearing lobes or branches of *Studeriotēs mirabilis*.—It shows the terminal polyp much larger than the others. $\times 12$.

colony, with a large retractile polyparium. The cup is 45 mm. in height by 55 mm. in maximum diameter, and it is continued into a basal wisp (19 mm. in length), which, however, shows no attaching disk. The specimen gave indication of having been imbedded in the mud up to about the maximum diameter of the cup.

General Structure.—The most striking peculiarity of *Studeriotēs* is that the whole of the polyp-bearing portion is retracted within the exceedingly substantial, densely spinose cup, the circular mouth of which is about 30 mm. in diameter, and shows the tips of numerous finger-like polyp-bearing lobes or

¹ I have named this very interesting type in honour of Professor Th. Studer, of Bern, who has contributed so largely to our knowledge of Alcyonaria. I gave a description of it at the International Congress of Zoologists in Boston (August, 1907) and at a meeting of the Royal Microscopical Society, 18th November, 1908. See "Journ. Royal Micr. Soc.," December, 1908. I had named it *Studeria*, unaware that this name was pre-occupied for a sub-genus of fossil echinoids. —J. A. T.

branches. It seems quite likely that the mouth of the cup was capable of more complete closure, and, on the other hand, that the retracted polyparium was capable of considerable protrusion.

A longitudinal median section of the single specimen shows a dome-shaped fleshy centre, or thalamus, from the margins and summit of which most of the numerous finger-like polyp-bearing lobes arise. Some of them, however, are attached to the inner wall of the cup at different levels. The central dome, it should be noted, rises quite freely in the middle of the cup; its diameter is

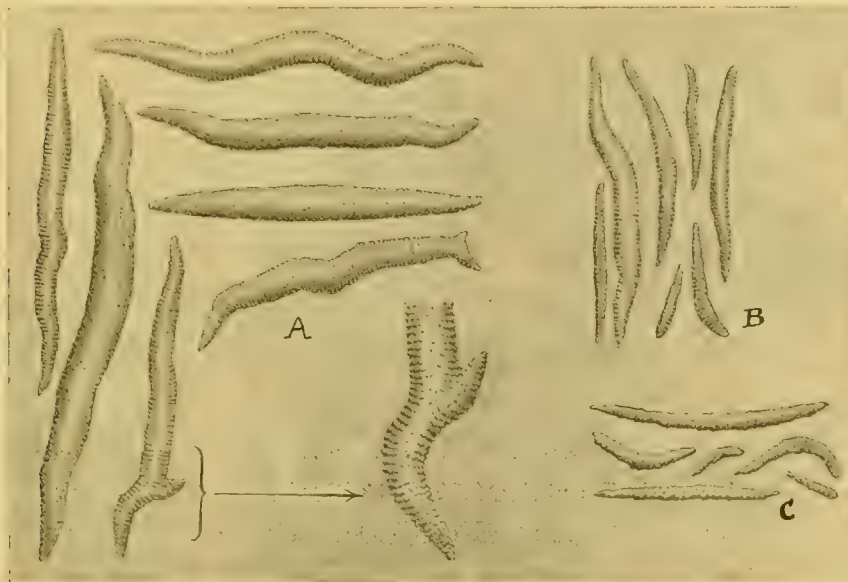


Fig. 5. Spicules of *Studeriotes mirabilis*.—A. From the stalk. B. From the internal wall of the cup. C. From a polyp-bearing lobe.

greater than half the maximum diameter of the cup. The arrangement of the polyp-bearing lobes may be compared to the distribution of carpels and stamens in the flower of some of the Rosaceæ, in which the former are disposed on a dome-shaped central thalamus, and the latter on several whorls on the inner wall of the “calyx-tube”. Or, again, the central region of our specimen may be compared to the disk of a Composite’s capitulum and the peripheral parts to the ray-florets. Fig. 3.

There are large longitudinal canals in the central dome, separated by tough hyaline mesogloæ. Very strong muscle-bands pass down their walls, and there are others in the wall of the cup reaching almost to the margin. These longitudinal bands pass for a short distance into the wisp-like stalk and gradually disappear. Numerous well-defined transverse muscles extend between the several longitudinal bands.

The Cup.—The cortical part of the wall of the cup, which is very definite and has a thickness of about 2 mm., is extremely hard, consisting mainly of long

spindles, readily visible to the naked eye (some over 5 mm. in length), arranged for the most part in longitudinal interlacing rows. On the surface many of the spindles lie exposed throughout their whole length. Towards the base of the cup the spicules increase in size, and they attain their maximum dimensions—almost 1 cm. in length—in the basal wisp. These are probably the largest Alcyonarian spicules as yet known.

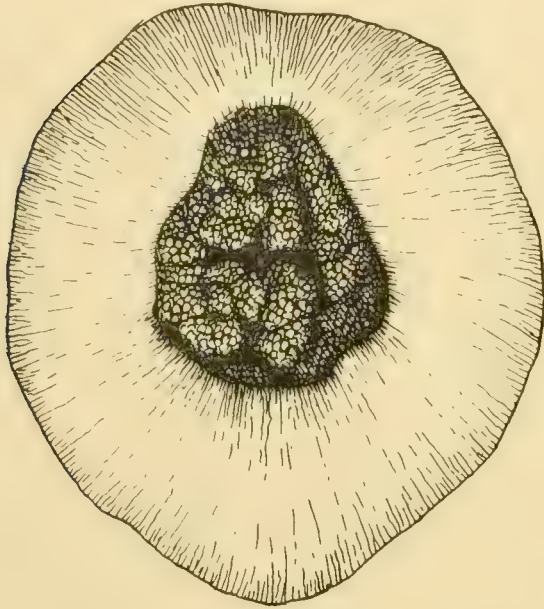


Fig. 6. View of the colony from above, showing tips of polyp-bearing lobes occupying the mouth of the cup.—About natural size.

The internal part of the wall of the cup, as distinguished from the hard cortex just described, is soft and muscular. It is about 9 mm. in thickness where it joins the base of the dome, and narrows gradually to the margin of the cup.

The System of Canals.—Each of the finger-like polyp-bearing lobes has a large canal, with which the cavities of the polyps communicate. These branch canals pass into the dome or the wall of the cup, as the case may be, and uniting with others form the main longitudinal canals. These are relatively large, especially at the base of the cup and below the central dome, where they are about 2.5 mm. in diameter. From this

region of maximum size, they gradually taper into the wisp-like stalk. The walls of the canals bear the strong longitudinal muscle-bands, and there are very few spicules.

Polyp-bearing Lobes or Branches.—Looking down into the mouth of the cup, one sees the heads of between sixty and seventy polyp-bearing lobes or branches, but the number visible will of course depend on the degree to which the dome is contracted. Besides the branches on its summit, the central dome bears four whorls, and there are also four tiers on the wall of the cup. It should be noted, however, that the lobes do not all arise singly from the central dome, but may cohere for a distance of 2.6 mm. at their bases. Some are united in pairs; in one case seven were found to be cohering.

Polyps.—Each of the finger-like branches resembles a spike-inflorescence, and bears 150-200 close-set sessile polyps. These almost cover the surface, but without discernible arrangement. At the summit there is a terminal polyp which is larger than the others. In many cases a branch has a length of 15 mm. and a maximum diameter of 3 mm., but in regard to these and other

measurements of soft parts it must be remembered that the whole colony has been much contracted by preservation in strong spirit. Fig. 4.

The polyps have almost globular calyces or verrucæ, with a diameter of about 1 mm. The tentacles are in most cases completely retracted, and the summit of the calyx shows a sharply defined circular aperture. The polyps with their calyces and precise circular aperture recall those of some of the Pennatulids, such as Virgularids. On the wall of the calyx there are eight triangular points, each consisting of two to three pairs of spicules arranged *en chevron*, surmounting a collaret of several horizontal rows. In most cases, however, the projecting spindles of the cortical cœnenchyma hide the base of the calyx and may even intrude upon it. The polyp itself is very minute and is completely retractile within the globular calyx. The tentacles are short and thick, apparently without spicules, and with about half a dozen pairs of pinnules.

Spicules.—Apart from a few irregular minute forms found on the canal walls (and possibly extraneous), all the spicules are spindles. Many are huge, most are densely warted. The warts are often in close-set transverse rows, so that the spindle has a striated appearance. Many of the spindles are curved in a sinuous fashion; not a few are irregularly forked. Fig. 5.

The following measurements were taken of the spicules, length and breadth in millimetres:—

From the stalk :	9·5 × ·534 ;	7 × ·51 ;	5·75 × ·476.
From the cortex :	5·5 × ·476 ;	3·5 × ·28 ;	1·75 × ·153.
From the inner wall of the cup :	} 5 × ·4 ;	3 × ·28 ;	2 × ·15 ; 1 × ·125 ; 9 × ·1.
From the canal walls :	6 × ·51 ;	4·25 × ·4 ;	2·75 × ·32.
From the polyps :	1·6 × ·112 ;	1·02 × ·05 ;	·45 × ·034 ; 17 × ·018 ;
			·13 × ·017.

Position of Studeriotes.—If this type is to be referred to any of the recognised families of the Alcyonacea it must be to the Alcyoniidæ or to a position between Alcyoniidæ and Nephthyidæ. In the retractility of the whole polyparium, as well as in the mode of branching, the disposition of the polyps and their armature, it is removed from the Nephthyids and Siphonogorgids.

In certain respects, *e.g.*, the distinct calyces into which the delicate upper parts of the polyps are retracted and the large longitudinal canals continued in part to the base of the colony, *Studeriot*es resembles *Nidalia*, but the *Nidalia* colony is unbranched, and there are many other differences apart from the retractile polyparium. In certain respects, *e.g.*, in its huge spindles and in the finger-like lobes densely covered with polyps, *Studeriot*es resembles a form like *Sclerophytum polydactylum*, but the polyps are quite different in the two, and there is not in *Studeriot*es any hint of dimorphism. The non-retractile calyces,

the mode of branching, the nature of the spiculation, and other features separate *Studeriot*es from *Alcyonium* and several nearly related genera. So we might review all the genera of Alcyoniidæ, but to little profit, for there is only one which can be thought of as having close affinities with our new type. That one is the genus *Paralcyonium*, established by Milne-Edwards. Milne-Edwards gave the following diagnosis of *Paralcyonium*: "Polyparium of a coriaceous tissue towards the base and there forming a cylindrical tube with spiculose walls, into the interior of which all the upper and soft part of the polyparium, including the polyps themselves, can be completely retracted" ("Histoire Naturelle des Coralliaires," 1857, p. 129).

In his original description of *Paralcyonium*, when he called it Alcyonide ("Ann. Sci. Nat.," ser. 2, iv. (1835), pp. 323-33 (9 figs.)), Milne-Edwards gave a number of interesting details. He distinguished a brown firm "foot" fixed by its base, and a white, delicate, branched trunk with twigs ending in small polyps. The cavities of the polyps unite in forming longitudinal canals which are continued to the base, those which lie to the outside having their walls strengthened by numerous brown spindles. Ova are developed on lamellæ in the lower part of the canals of the trunk and fall into the cavity, accumulating further down. On the polyps there are, according to Milne-Edwards, rows of "spicules cartilagineuses brunâtres".

Wright and Studer gave the following definition of *Paralcyonium* in the "'Challenger' Report" on Alcyonarians (1889): "The colony presents two distinct portions: one, the basal portion, is dense, with firm walls; the other, the head, alone bears the polyps, and can be in part withdrawn into the basal part. The polyp-bearing portion is but feebly lobed." In his "Versuch eines Systemes der Alcyonaria" ("Arch. Naturges.," liii. (1887)), Studer had suggested affinity with *Nidalia*.

Our new type *Studeriot*es agrees with *Paralcyonium* (1) in having the polyp-bearing portion retractile into the basal portion; (2) in the disposition of the longitudinal canals, and (3) in having very large fusiform spicules. But there the resemblance stops, and there can be no question as to the distinctiveness of the two very remarkable genera.

The most obvious differences between *Studeriot*es and *Paralcyonium* may be summed up in the following contrast:—

*Studeriot*es *mirabilis*.

The polyps are crowded on numerous finger-like branches, which cover a central dome, and also grow out from the inner walls of the cup.

Paralcyonium *elegans*.

The polyps are distant from one another, and are borne on the ends of the twigs of a loosely-branched polyparium.

Studeriotēs mirabilis—cont.

The polyps have a dense armature of spicules, forming a well-defined calyx.

The walls of the cup are very massive and hard.

The retractile polyparium is very substantial, including strong muscle-bands.

The larger spindles are very characteristic, being covered with warts in thick-set rows.

Paralecyonium elegans—cont.

The polyps have minute spicules at the base of the tentacles, but there is no calyx.

The walls of the cylindrical lower portion are not thick, and the whole is readily compressible.

The retractile polyparium is very delicate and translucent.

The spindles are much smaller, and much less warty.

It should be noted that *Studeriotēs mirabilis* is much larger than *Paralecyonium elegans*, much more massive, with much larger and coarser spicules, and so on; but we have reason to believe that the massiveness of architecture is a specific, not a generic character. We saw in September in the Zoological Museum in Hamburg a number of unnamed specimens of a form which we believe to be closely related to *Studeriotēs*. By the courtesy of the director, Professor Kraepelin, and of Dr. Michaelsen, who has charge of the section of the museum containing Alcyonaria and the like, we were able to examine this form, and to compare it with the "Investigator" type. The Hamburg specimens, which were collected off Formosa (Takao), agree with the "Investigator" specimen in having a retractile polyparium, similar polyps, and the same type of huge warty spindle, but they have not the strong massive cup, nor, so far as we have seen, the same development of central dome, or of digitiform lobes. We do not wish to pursue the comparison in the meantime, since Professor Kükenthal has, we believe, undertaken to describe the unnamed Alcyonarians in the Hamburg Museum. We would, however, express our conclusion that the Hamburg specimens belong, or are closely related, to the genus *Studeriotēs*, which we have established for the "Investigator" type.

M. Camille Viguiér¹ has described and given beautiful figures of a type which he calls *Fascicularia*, and has proposed to include *Paralecyonium* along with it in a special family or sub-family, Fascicularinæ. But it is not evident that *Fascicularia* is really related to *Paralecyonium*: it consists of groups united by stolons; the cavities of the polyps are continued, quite distinct from one

¹ Études sur les animaux inférieurs de la Baie d'Alger. III. Un nouveau type d'Anthozoaire (*Fascicularia edwardsi*). "Arch. Zool. Expér.," ser. 2, vi. (1888), pp. 351-73 (2 pls.). See also H. de Lacaze-Duthiers: Coralliaires du Golfe du Lion. Alcyonaires. "Arch. Zool. Expér.," ser. 3, viii. (1900), pp. 353-462 (4 pls.).

another, down the "basilar column"; there is no common region except the base; the large polyps expand from the top of the basilar column, but there is no branched or lobed polyparium; in fact, as the author says, there is no polyparium properly so-called. He makes the same remark, it is true, in regard to *Paralcyonium*, which, however, he had not seen. What at once marks *Paralcyonium* as distant from *Fascicularia*, is the presence of a branched polyparium rising from the top of a firmer cylindrical stalk, into which it can be retracted. Viguier speaks of the "incontestable resemblance" between his *Fascicularia* and the *Paralcyonium* of Milne-Edwards, but we are unable to share this view. The description of *Fascicularia* suggests to us relationship with *Sympodium* rather than with *Paralcyonium*.

A recent careful study of abundant material of *Fascicularia* and *Paralcyonium* by Sophie Motz-Kossowska and Louis Fage ("Contribution à l'étude de la famille des Fascicularidés," Arch. Zool. Expér., vii. (1907), pp. 423-43 (10 figs.)) corroborates Viguier's view. In their interesting paper the authors point out that the two types agree (1) in having a stolon connecting the colonies (but this is often almost suppressed in *Paralcyonium*); (2) in having a rigid basal portion into which the polyps can be retracted (but in *Fascicularia* this is composed of the unfused gastric cavities of the polyps, whereas in *Paralcyonium* there has been much coalescence, and therefore far fewer longitudinal canals than polyps; moreover, *Paralcyonium* has a branching polyparium with secondary polyps arising from primary polyps); (3) in having similar spicules—small flat, opaque elliptical forms in a sub-tentacular collar and larger spindles in the basal portion (but the spindles are very much larger in *Paralcyonium*). The authors point out that *Paralcyonium* passes through a *Fascicularia* stage, and in spite of the great difference in the basilar portion and in the relations of the polyps to one another, they unite them in the family Fascicularidæ, defined as follows: "Colonies very poor in cœnenchyma, composed of several groups of polyps united by a stolon; polyps united at the base in a rigid column within which they can be completely retracted". It is suggested that the family is connected by *Fascicularia* with the Clavularidæ, that there are some affinities with *Nidalia* and *Nidaliopsis*, and that the nearest related form is *Organidus*. The armature of the polyps in *Nidalia*, its unbranched habit, and many other features separate it far from *Paralcyonium*, and *Gersemia*, to which, as Kükenthal has shown, *Organidus* must be referred, is equally remote.

We have not as yet been able to procure a specimen of *Fascicularia* for examination, and we would not therefore dogmatically exclude the possibility that *Fascicularia*, *Paralcyonium* and *Studeriotus* form a series showing the progressive differentiation of a rigid basilar portion into which the rest of the colony can be retracted. The descriptions given by Motz-Kossowska and Fage are very precise, and their discussion of the possible relationships is admirable;

what surprises us is that in spite of the differences which they indicate between *Fascicularia* and *Paralcyonium*, they should propose to include the two in one family. From their descriptions, as from Viguier's, it appears to us that *Fascicularia* is more nearly related to *Sympodium* than to *Paralcyonium*; that it differs from *Paralcyonium* too markedly (in the structure of the basilar portion and in the relations of the polyps to this and to one another) to allow of their being included in one family; and that neither is nearly related to *Studeriotas*.

Diagnosis of Studeriotas.—A colony consisting of a strong densely spiculose cup, within which very numerous finger-like polyp-bearing lobes or branches are retracted; these arise at different levels from a strong muscular central thalamus, and from the upper parts of the inner wall of the cup; each finger-like lobe is thickly covered with polyps and ends in a polyp larger than the rest; the cavities of the polyps communicate with a central canal in the digitiform lobe, and these central canals unite in a few large longitudinal canals with few spicules in their walls; the polyps have a distinct non-retractile calyx or verruca, covered with spindles arranged in double rows; the spicules are all spindles, except a few minute irregular forms found (along with sparse spindles) in the canal walls; many of the cortical spindles attain huge dimensions (over 9 mm.); many are sinuous and forked; almost all are very warty, and there is a characteristic arrangement of the warts in transverse rows.

Our general conclusion, which is based on a single specimen, of which we had to be careful, is that we have to do with a very distinct genus, related to *Paralcyonium*, but not very closely; perhaps connected through forms like *Nidalia* with other Alcyoniidæ; but more probably deserving, as Professor Verrill suggested to us, the establishment of a new family.

Family NEPHTHYIDÆ.

Sub-family Spongodinæ.

Nephtya glomerata, n. sp.

„ *tenuispina*, n. sp.

Dendronephtya (syn. *Spongodes*), numerous species.

GENUS NEPHTHYA, Savigny.

Nephtya glomerata, n. sp.

Several specimens of an orange-brown colour markedly flattened in one plane. The largest, which is 55 mm. in height, 40 mm. in breadth, and 15 mm. in thickness, is attached to a piece of bivalve shell. It consists of an almost cylindrical stalk, about 15 mm. in diameter, from the lateral surfaces of which

arise nine polyp-bearing lobes, five on one side and four on the other. These again bear smaller catkin-like outgrowths covered with polyps.



Fig. 7. *Nephthya glomerata*, n. sp.—General view of a piece of the colony. Enlarged about eight times.

The surface of the central portion is paler in colour than the polyps and presents a glistening arenaceous appearance, and when viewed with a lens appears transversely corrugated. Embedded among the smaller spicules are a number of long warty spindles arranged transversely.

The canals are large and almost circular in section; they are few in number, and are supported by thin walls which contain very few spicules. The outer wall is tough and hard; it is densely packed with small spicules and forms the support of the colony.

The polyps are disposed over the whole surface of the lobes, sometimes appearing almost as if in whorls. On the main trunk small groups occur, sometimes arising directly, at other times having a short support. The polyp-stalk is about 1.25 mm. in length and the body about 1 mm. They are supported by a fairly definite "Stützbündel" consisting of four to six thick spindles, the uppermost pair of which generally project for a short distance. The orientation of the polyps is such that all the oral openings are directed towards the supporting lobe and are closely apposed to it. On the body-wall the spicules are arranged "en chevron" in eight groups which form definite ridges culminating in triangular points at the base of the tentacles. On the aboral surface of the tentacles the spicules are arranged "en chevron".

The spicules are chiefly spiny and warty spindles, but small irregular bodies occur in the outer wall. The spindles vary greatly in proportion of length to breadth: in some the spines are much elongated and in others they are bifurcated. The following are some of the measurements length by breadth in millimetres:—

(a) "Stützbündel," 1.5×0.15 ; 1.7×0.12 .

(b) Polyp, 0.8×0.12 ; 1×0.14 .

(c) Outer wall, spindles, 1×0.075 to 0.3×0.04 .

Irregular forms, 0.015×0.015 ; 0.01×0.01 .

Locality: Gaspar Strait, East Coast of Sumatra.

Nephthya tenuispina, n. sp.

Several small but complete colonies attached to pieces of rock, the largest is 3 cm. in height. From a spreading base, 1·8 cm. in diameter, the main portion arises, but this soon gives origin to several long, slightly tapering lobes. These diverge in all directions, some even growing downwards. Polyp-bearing lobes occur all over these secondary branches. A cross-section through one of the larger lobes presents a radiate structure, the canal walls passing from the centre to the circumference, but this becomes obscure in the older portions by the development of smaller canals towards the periphery. The outer wall is tough and rigid and is densely filled with long spiny spindles.

The polyps are borne on catkin-like outgrowths of the larger lobes, but on the main stem they occur in groups separated by considerable intervals—seldom singly.

The surface of the whole colony is covered with long, straight or curved spindles, generally arranged in groups and disposed longitudinally. On the smaller lobes, where the polyps are more crowded, the arrangement is much more irregular, but here also the grouping is a marked feature.

The polyps are almost 2 mm. in length, the stalk being slightly over 1 mm. The “Stütz-bündel” consists of about six long thick spindles, grouped into a sheaf, projecting for a considerable distance beyond the origin of the body of the polyp.

The polyp stands at right angles to the stalk and is directed towards the colony, but when the tentacles are fully retracted the oral part projects downwards. Spicules longitudinally arranged cover the whole surface, but there is a hint of eight groups at the base of the tentacles.

The spicules are straight and curved, spiny and warty spindles and present the following range of measurements length by breadth in millimetres :—

1·6 × 0·15 ; 1·5 × 0·12 ; 0·9 × 0·04 ; 0·7 × 0·03 ; 0·3 × 0·02.

This species is remarkable for the great slenderness of the spindles.

Locality : Andamans. Marine Survey.



Fig. 8. *Nephthya tenuispina*, n. sp.
—The top of two branches,
enlarged about eight times.

Genus *Dendronephthya*, Kükenthal (= *Spongodes* of most authors).¹

The classification adopted is that given by Prof. Kükenthal in his "Versuch einer Revision der Alcyonarien" (1905).

The genus *Spongodes* was established in the year 1834 by Lesson for a species described by him, *Sp. celosia*. Dana changed the name to *Spoggodia* (1846) without giving any special reason, and placed in this genus *Alcyonium floridum*, Esper, in addition to *Sp. celosia*, Lesson, and a variety *Sp. celosia* β *arborescens*. Milne-Edwards (1857) gave an account of the differences between *Spoggodia* and *Nephthya*, and curiously enough his descriptions are based not on *Sp. celosia*, Lesson, but on Dana's *Sp. celosia* β *arborescens*.

J. E. Gray (1859) first placed *Spoggodia* in the genus *Nephthya*, but later adopted Lesson's genus and divided it into two sub-genera, *Spoggodia* and *Spoggodia*.

Klunzinger (1877) placed *Spongodes* along with *Nephthya* and *Ammonothea*, but while adopting Gray's sub-genera gives them a different diagnosis. Our knowledge was extended when Wright and Studer published (1889) their account of the "Challenger" Alcyonaria. Holm (1895) separated *Nephthya* from *Spongodes*, and divided the whole genus into four sub-genera. In 1896 Kükenthal separated *Spongodes* from *Nephthya*, and his classification has been followed by Burchardt (1896), May (1899) and Pütter (1900).

In 1905 Kükenthal pointed out that the great diversity of diagnoses given for the genera *Spongodes* and *Spoggodia*, and the fact that the genus *Spongodes* was founded for what is now *Nephthya celosia*, made it necessary to withdraw the name *Spongodes*. He proposed to replace the genus *Spongodes* by the two genera *Dendronephthya* and *Stereonephthya*, and gave precise definitions of these.

The collection is remarkable for the large representation of the *Diraricatæ* and *Umbellatæ* divisions of Kükenthal's classification and also for the large number of forms that seem to lie on the border line between the main divisions.

DIVISION GLOMERATÆ.

Dendronephthya irregularis, Henderson.

This species is founded for a large colony of about 16 cm. in length and about 12 cm. in greatest breadth.

The stalk or trunk is long, measuring about 5 cm., greatly shrunken, and

¹ As mentioned in the introduction, the description of the species of *Spongodes* or *Dendronephthya* is the work of Dr. W. D. Henderson; and the new species, which have been very briefly reported in the *Zoologischer Anzeiger*, must therefore bear his name. It may be noted that Mr. Henderson did this work during part of the time of his tenure of a Carnegie Fellowship, and in Prof. Kükenthal's laboratory in Breslau. I wish to take this opportunity of thanking my German colleague for his generous assistance in this and other instances.

marked by numerous large longitudinal ridges and furrows, and having its upper portion partially hid by the reflexed flattened branches. It is leathery in texture and granular in appearance.

The polyparium is very large, markedly flattened in one plane, and consists of a number of principal branches which rise on opposite sides of the stem in the same plane. Each of these bears secondary branches from which smaller branches are given off. These again, by repeated division, give rise to the polyp-bearing twigs. All over the stem and principal branches smaller branches arise which bear the polyps in clusters at the tips. The lower branches are flattened, fold-like or leaf-like expansions, two of which are very large and almost surround the stem, and give off from their upper surface ordinary branches. Slightly below these a number of smaller branches are given off which are cylindrical in the lower portion and flattened in the upper portion, and slightly above the two large flattened branches other smaller branches, flattened in their upper portions, are given off. The whole polyparium is characterised by the prominent branching, and by its loose, open appearance, the marked flattening in one plane, and the leaf-like lower branches.

The polyps are arranged in small clusters at the end of small twigs which arise not only from the small branches but also from the general surface of the stem and larger branches. They also occur singly or in still smaller clusters on the edges of the flattened branches. The spicules are arranged in the following manner: at the base there are eight double rows of about two pairs of spicules each, then above these a number of irregularly arranged spicules, and rising above the latter eight points in each of which there is one pair of converging spicules. The spicules average about 0.32 mm. in length, but the uppermost measure about 0.4 mm. and may project a little beyond the polyp. On the aboral surface of each tentacle there are two rows of small flat spicules.

The Stützbündel is poorly developed, and contains only a few spicules, one or two of which reach a length of 0.9 mm. and scarcely project beyond the polyp. In some cases the Stützbündel is more strongly developed and contains larger spicules.

Cortical spicules: (a) In the stem there are long, slender spindles with numerous regularly arranged, simple spines, and a few small, flat, smooth spindles with toothed edges. The larger spindles average about 1.7 mm. in length.

(b) In the stalk there are spindles, three and four-rayed forms, Y-shaped forms, and numerous small, incipient three- and four-rayed forms whose centre bears a distinct X-shaped marking, irregular spindles, branched in various ways, flat disc-shaped forms, irregular clubs and stars. All have a marked striation on the surface, and the majority have prominent rough, simple to branched spines, while some have fewer and simpler spines. The spindles also

show an aggregation of the spines on the convex side, and in these cases, the spines are usually strongly developed. The spindles average about 1 mm. in length.

Canal-wall spicules: (a) In the stem the canal walls are thickly filled with small, flat, spindle-shaped to star-shaped spicules.

(b) In the canal walls of the stalk there are a very few spindles and star-shaped forms and numerous very small disc-shaped bodies.

Colour—The stalk is greyish-white; the stem and larger branches white to semi-transparent with a yellowish-brown tinge; the remaining branches and twigs, light brown to deep brown; the polyps white.

Locality: Andamans.

Dendronephthya ovata, Henderson.

A small specimen about 7 cm. in total height and about 3 cm. in greatest breadth.



Fig. 9. *D. ovata*.



Fig. 10. *D. ovata*.—
Spicules of stalk cortex.

The stalk or trunk is long (4 cm.), fairly thick and greatly shrunk. It is leathery in texture, granular in appearance, and has the upper portion hidden by reflexed flattened branches.

The polyparium is egg shaped, slightly flattened on one side, that side having less well-developed branches. Two of the lowest branches are flattened leaf-like structures and almost surround the stem, leaving only two small free

spaces in which two small ordinary branches arise. Slightly further up the stem one or two large branches arise, and all round the stem and larger branches, smaller branches are given off which by division give rise to the polyp-bearing twigs.

The polyps are arranged in small groups of about five each, and are placed at practically a right angle on a stalk of about 1.5 mm. in length. The heads are low and round, measuring about 0.48 mm. in height and 0.56 mm. in breadth. The spicules are arranged in the following manner: At the base of the polyp there are a few irregularly arranged spicules, sometimes bluntly converging, sometimes horizontally placed; then a ring of horizontal spicules, three deep; and rising above this eight points each consisting of a single pair of converging spicules. In the points there may be a third spicule lying parallel to one of them. The lower spicules average about 0.33 mm. in length and the upper about 0.6 mm., but the upper may reach a length of 0.9 mm. and project for a distance of 0.3 mm. beyond the polyp.

The Stütz Bündel is well developed, one of its spicules usually reaching a length of about 2.6 mm. and projecting more than 0.8 mm. beyond the polyp.

Cortical spicules: (*a*) In the stem they are thickish spindles, blunt at the end, with numerous rough, blunt spines, the larger averaging 1 mm. in length, the smaller, about 0.6 mm.

(*b*) In the stalk there are short and broad spindles which show great variation in length but a more marked variation in breadth; they are straight or curved and may be even C- and S-shaped. A few show two whorls on their surface. There are also a very few incomplete three-rayed forms. All bear numerous multituberculate warts. Smaller spindles average 0.6 mm. in length, larger spindles are about 1.35 mm. long and about 0.22 mm. broad. Spindles up to 2.25 mm. long and 0.4 mm. broad are present.

Canal-wall spicules: (*a*) In the stem there are a number of short spindles with rough warts.

(*b*) The spicules of the stalk are similar to the preceding but are more numerous, and there also occur smooth, flat, striated spindles with few protuberances, irregular three- and four-rayed forms, and spindle- to star-shaped forms with toothed edges.

Colour—Stalk, stem and lower part of branches, greyish-white; upper part of smaller branches and polyp-twigs, whitish to whitish-brown; polyps brown.

Locality: Station 78; off Ganjam Coast.

Dendronephthya köllikeri, var. *andamanensis*, Henderson.

The colony is very large, measuring 8.5 cm. in height and 11 cm. in breadth. It is much flattened in one plane, and its branches have the appearance of portions of a whin-bush.

The stalk or trunk is thick and short, measuring almost 2 cm. in length, and has a broad base of attachment. It is granular in appearance.

The polyparium is very large, much flattened, and consists of two principal branches, one of which divides into two. Below these are given off the lower branches which are reflexed, flattened, leaf-like structures with broad bases which almost surround the stem, forming a collar to the upper portion of the stalk. From the principal branches numerous smaller branches are given off, which by repeated division give rise to the polyp-bearing twigs. The whole polyparium is characterised by the great growth of the three principal branches, by the profuse, irregularly arranged branches which rise from the whole surface of the stem and principal branches, by the large spicules which are arranged transversely, and by the large projecting spicules of the Stützbündel.

The polyps are arranged in small bundles of five to seven, which are placed on widely diverging stalks of about 1 mm. in length, at an angle which varies from right to obtuse. They occur singly on the edges of the flattened branches and either singly or in small groups on the upper surfaces. They are slightly oval in shape and average about 0.6 mm. in height and 0.78 mm. in breadth. The polyp-spicules are arranged in eight double rows in each of which there are three to five pairs of converging spicules, of which the uppermost pair is much longer and projects considerably beyond the polyp. The lower polyp-spicules average about 0.35 mm. in length, while the upper projecting spicule measures about 0.72 mm. and may project 0.36 mm. beyond the polyp. They are more or less straight spindles and have a number of blunt spines. The projecting spicule is more thickly covered with blunt spines, and on the projecting part the spines are directed obliquely towards the tip.

The Stützbündel is well developed and consists of several spicules, one of which measures 3.8 mm. in length and projects about 1 mm. beyond the polyp.

Cortical spicules : (a) In the stem there are straight, curved or crooked spindles, short, broad spindles forked at one end, and a few globular bodies. All are covered with prominent rough warts regularly arranged on the surface. The spindles vary from 0.48 to 6.5 mm. in length and from 0.06 to 0.66 mm. in breadth. They are arranged transversely on the stem and principal branches, and more or less longitudinally on the smaller branches and twigs.

(b) In the stalk there are thick spindles, straight or curved, cylindrical rods, clubs, three- and four-rayed forms, rough globular forms, flattish, irregular forms which may or may not be branched, and irregular stars. All bear

numerous regularly arranged, blunt warts which may be branched. The spindles vary from 0.33 to 1.8 mm. in length, and from 0.15 to 0.33 mm. in breadth; the rods vary in length from 0.4 to 1 mm. The three- and four-rayed forms average about 0.9 mm. in greatest length, the clubs about 0.5 mm.

Many of the spindles are forked at one end, the prongs lying close together, or spreading apart and simulating three-rayed forms. There are also spindles which give off a short branch about the middle of their length, and others with prominent thorns and warts on the convex side.

Canal-wall spicules: (*a*) In the stem the spicules are similar to the spindles in the cortex of the stem and are covered with numerous regularly arranged, blunt, rough spines or simple warts, and vary from 0.6 to 3.6 mm. in length and from 0.09 to 0.42 mm. in breadth.

(*b*) In the stalk the spicules are similar to those of the cortex of the stalk, huge, thick spindles, forked spindles, three- and four-rayed forms, all bearing numerous large, very rough or branched warts. The spindles measure up to 2.4 mm. in length and 0.25 mm. in breadth, the three-rayed forms up to 1.38 mm. in greatest length. In addition there is a series corresponding in every shape and differing only in being slightly smaller and in having fewer and simpler though longer rough warts. Many of the latter type of spindle give off three or four branches about the middle point, and the four-rayed forms are usually more irregular.

Colour—The stalk is yellowish-white, the stem and principal branches are white, the smaller branches and twigs pale pink with violet tinge, the polyps brownish-yellow.

Locality: Table Island (Cocos); Andamans, 15 to 35 fathoms.

This specimen comes very near *D. köllikeri*, Kükth., but differs from it in the number of spicules in each double row, and in the greater variety of spicules in the cortex and the canal walls. It may be regarded as a new variety of *D. köllikeri*.

Dendronephthya colombiensis, Henderson.

This species is represented by two specimens, the larger of which measures 10 cm. in height and about 7 cm. in greatest breadth.

The stalk or trunk measures 3 cm., about one-third of the total height of the colony. It has numerous longitudinal folds and shows at the base the remains of several slender stolons.

The polyparium is very irregular in shape, flattened in one plane, loose and open in appearance, and very rigid. From the lower part of the stem a number of small branches arise, the lowest of which are flattened leaf-like structures. A short distance above, the stem gives off two principal branches, one standing

at right angles, the other rising at an acute angle to the stem. The stem then rises without giving off any more principal branches, but tends slightly towards



Fig. 11. *D. colombiensis*.

the side on which the branch stands at an acute angle. From the whole surface of the stem and principal branches, smaller branches are given off which by a kind of repeated dichotomy give rise to the polyp-bearing twigs. The lower flattened, leaf-like branches almost surround the stem, leaving only two small free spaces which are occupied by two smaller branches which arise at a lower level. Of these smaller branches the stalk is cylindrical in the one, flattened in the other, and in both the upper portion is flattened and occupies the triangular space left between the edges of the flattened folia. Directly above these openings there arise two flattened branches,

the upper portion of which divides more or less similarly to the ordinary branches, and at the base of the principal branches one or two slightly flattened branches also occur. From the edges of the flattened folia small ordinary branches arise.



Fig. 12. *D. colombiensis*.—*b*, from stalk cortex; *c*, from stalk canal walls.

The polyps are arranged in small groups of four to eight which stand closely together on the upper part of the polyparium and more distantly in the lower part. On the edges of the flattened branches the polyps occur singly or in small groups. They measure about 0.6 mm. in height and 0.6 mm. in breadth and are placed at a right or obtuse angle on the stalk, which measures 1 mm. in

the upper and about 1.5 mm. in the lower part of the polyparium. The spicules are arranged in eight double rows, there being in each lateral row six to eight pairs of converging spicules, in each ventral row usually three to five pairs, and in each dorsal about four pairs. In the lateral rows one of the second uppermost pair is a little longer and may project beyond the polyp. The spicules measure on an average 0.36 mm. in length, the longer projecting spicules, however, may measure fully 0.4 mm. in length. On the aboral surface of each tentacle there are two rows of small, flattish, rod-like spicules.

The Stützbündel is well developed and has a number of large spicules, one of which may reach a length of 3.6 mm. and project 0.7 mm. beyond the polyp. Usually the tip of a second spicule also projects.

Cortical spicules: (a) In the stem there are straight or curved spindles usually forked at one end, and covered with regularly arranged prominent roughish warts. They measure from 0.3 to 6.5 mm. in length and from 0.03 to 0.48 mm. in breadth. The smaller have comparatively fewer and simpler warts. They are arranged more or less transversely on the stem and principal branches, becoming more longitudinal on the smaller branches and twigs.

(b) In the stalk there are short, thick spindles, clubs, three-, four- and five-rayed forms, oval forms and irregular stars, all these having numerous rough, often branched warts and huge spines, the latter occurring especially on the edges. In addition there are smooth, flattish spindle- to star-shaped forms. The rough spindles measure about 1.6 mm. in length and 0.30 mm. in breadth, the five-rayed have a spread of 0.9 mm., the four-rayed measure up to 1 mm., and the clubs average about 0.42 mm.

Canal-wall spicules: (a) In the stem there are huge spindles, three- and four-rayed forms, and incipient tripod forms all covered with prominent blunt spines and rough warts, and in addition smooth, flat, spindle- to star-shaped forms. The spindles measure up to 4 mm. in length and 0.42 mm. in breadth, the three-rayed forms up to 1.6 mm. and the four-rayed forms up to 2.4 mm.

(b) In the stalk the spicules are similar to those of the canal walls of the stem, and in addition five-rayed forms, smaller spindles with few simple warts, and flattish rayed forms. They differ little, if at all, in size from the stem canal-wall spicules, but have only rough warts instead of blunt spines and rough warts.

Colour—The stalk is pinkish-white below, white above; the stem and principal branches are white; the smaller branches yellowish; the twigs yellowish in the upper part, yellowish-white to white in the lower part of the polyparium; the polyps red with white tentacles in the upper, white in the lower part of the polyparium.

Locality: Off Colombo, 26½ fathoms.

The smaller specimen, which measures about 6.5 cm. in height and about

5 cm. in breadth, agrees in almost every detail with the larger. It differs slightly in the size of the spicules and in the colour. The only difference of any importance is in the arrangement of the polyp-spicules, which are as follows : In the lateral rows five to eight pairs, and in the dorsal and ventral about four pairs.

The colour of the smaller specimen is as follows: The stalk, stem and principal branches are creamy-white, the smaller branches yellowish-white; the tips of twigs and polyp-stalks in the upper part reddish-pink; the polyps reddish-pink; tentacles, white. In the lower part of the polyparium, the twigs, polyp-stalks, polyps and tentacles are all white.

Locality: Off Colombo, $26\frac{1}{2}$ fathoms.

DIVISION DIVARICATÆ.

Dendronephthya cocosiensis, Henderson.

A specimen which measures about 8 cm. in height and 4 cm. in greatest breadth is the sole representative of this species.

The stalk, about 3 cm. long, is marked by numerous longitudinal ridges and furrows, and gives off a number of stolons from its base. It is somewhat granular in appearance and leathery in texture.

The polyparium is irregular in outline and slightly flattened in one plane, there being a more marked development of branches on one side than on the other, and on the former side there is a large branch which projects beyond the surface of the polyparium. The lower branches are slightly flattened, and are also slightly reflexed. From the surface of the stem and large branches smaller branches are given off almost at a right angle to the stem, and by their division give rise to the polyp-bearing twigs.

The polyps are arranged in small groups of five to nine on diverging stalks which may reach

a length of 2 mm. They are low, rounded bodies, measuring 0.48 mm. in height and 0.56 mm. in breadth, and are placed at a right angle on the stalks. The polyp-spicules are arranged in eight double rows, in each of which there are about seven pairs of converging spicules. The uppermost pair in each row is slightly larger and projects a little beyond the polyp. The lower polyp-spicules average about 0.256 mm. in length, while the upper average about 0.32

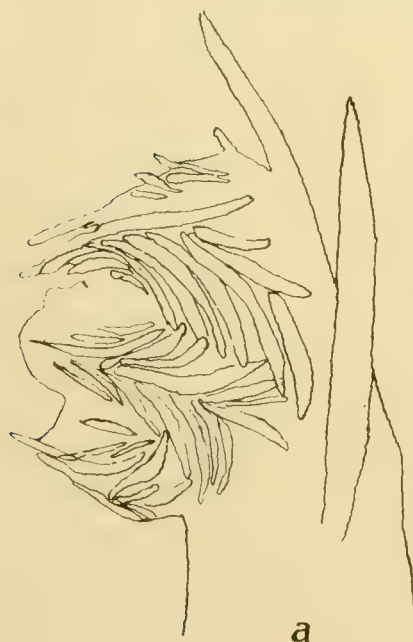


Fig. 13. *D. cocosiensis*.

mm. On the aboral surface of each tentacle there are two rows of small flat rod-like spicules.

The Stützbündel is well developed and consists of a number of spicules of about 1·2 mm. in length.

One of these projects beyond the polyp-head, and the tip of a second is also visible. In others the Stützbündel is more strongly developed and consists of a number of spicules, larger in size, one of which may reach a length of 2·4 mm. and project about 0·6 mm. beyond the polyp.



Fig. 14. *D. cocosiensis*.—*b*, Spicules of stalk cortex; *c*, Spicules of stalk canal walls.

Cortical spicules :

(*a*) In the stem the spicules are spindles with numerous regularly arranged rough warts. The smaller spindles average about 0·8 mm. in size, the larger about 3·2 mm.

(*b*) In the stalk there are short thick spindles, three-rayed forms and numerous irregularly branched spindles and stars, all thickly covered with numerous very rough warts. The spindles average about 0·6 mm. in length.

Canal-wall spicules : (*a*) In the stem there are spindles of about the same size as the spindles of the stem cortex but furnished with much simpler warts.

(*b*) In the stalk the spicules are similar to those of the cortex of the stalk but slightly larger and thicker.

Colour—The stalk, stem and branches white with a tinge of red ; the smaller branches, twigs and polyp-stalks yellowish-red ; the polyps yellowish-white.

Locality : Table Island (Cocos)

Dendronephthya purpurea, Henderson.

The specimen measures 6 cm. in height and about 4·7 cm. in maximum breadth.

The stalk or trunk is short and flabby, greatly wrinkled and contracted. It is granular in appearance and gives off from its base a number of stolons.

The polyparium is very irregular in shape, flattened on one side and rounded on the other ; it is fairly compact in the lower portion, but very open and

irregular in the upper, a few branches being more strongly developed than the others. From the lower part of the stem a large number of small branches are given off, and then the stem itself divides into two large branches which give off similar small branches. These small branches by repeated divisions give rise to the polyp-bearing twigs.

The polyps are arranged in small bundles of four to nine, and are placed at an obtuse angle on widely divergent stalks, about 2 mm. long. They are oval, about 0.48 mm. high and 0.56 mm. broad. The spicules are arranged in eight double rows in each of which there are five to six pairs, one of each uppermost pair being much larger and projecting considerably. The lower polyp-spicules average 0.24 mm. in length, the upper projecting spicule about 0.56 mm. The spicules are thick spindles and have numerous warts which are less developed on the projecting part. On the aboral surface of each tentacle there are two rows of short rod-like spicules.

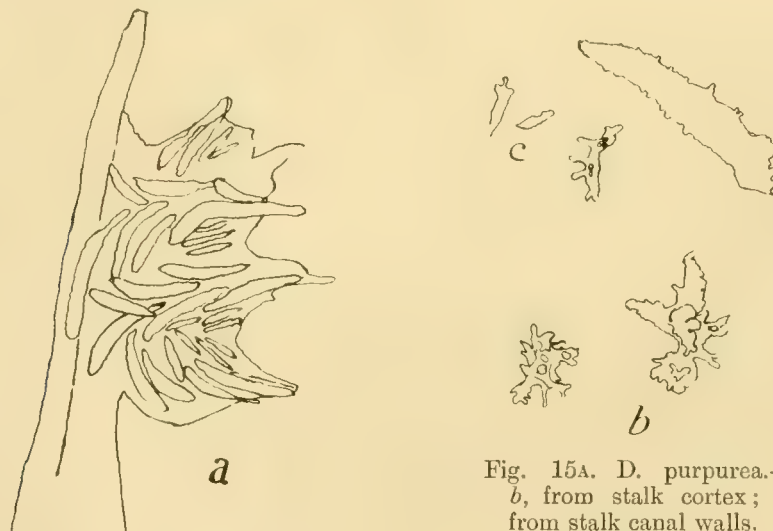


Fig. 15. *D. purpurea*.

Fig. 15A. *D. purpurea*.—
b, from stalk cortex; c,
from stalk canal walls.

The Stützbündel consists of a number of large spicules of which several may reach a length of 3 mm. and one may project for a distance of 1 mm. beyond the polyp-head.

Cortical spicules: (a) In the stem there are spindles curved or straight, four-rayed forms, four-rayed forms in which two of the rays are represented by stumps, all with numerous very small regularly arranged spines. There are also smooth, flat, irregular three and four-rayed forms. Several of the spindles have a number of very short stumps arranged in a whorl at one end. The large spindles average about 1.2 mm. in length, the small about 0.18 mm. Spindles of 1.6 mm. in length are present. The spicules are arranged more or less longitudinally.

(b) In the stalk there are irregular stars, spindles with one whorl of large

spines at each end, small thick spindles, and numerous irregular forms, all with large simple or branched spines. There are in addition a few flat, smooth striated forms.

Canal-wall spicules : (a) In the stem there are a very few minute disc-like bodies and a few smooth, flat, star to spindle-shaped forms.

(b) In the stalk the canal-wall spicules are similar to the preceding.

Colour—Stalk yellowish-white ; stem, branches and twigs deep purple-red ; polyps white.

Locality : Andamans.

***Dendronephthya cervicornis* (Wright and Studer) (= *S. rhodosticta*,
Wright and Studer).**

To this species we refer a large specimen which measures about 8.5 cm. in height and 8.5 cm. in greatest breadth.

In all essential details the specimen agrees with the description given of *Spongodes rhodosticta*, Wright and Studer, rather than with the type *D. cervicornis*, but there is no real distinction between these two.

The colour of the present specimen is as follows : The whole colony, with the exception of the polyp-stalks, twigs and portions of the smaller branches, is white ; the polyps and polyp-stalks are brownish-red ; the twigs and tips of the smaller branches a light brownish-red.

Locality : Station 291 ; Persian Gulf, 48-49 fathoms.

To this species we refer another specimen which measures 8 cm. in height and 6 cm. in greatest width. It is slightly bush-shaped, and very open in appearance, flattened in one plane, somewhat like a tree growing against a fence, with small branches going off in every direction, and owes its appearance to the unequal lengths of the branches. The texture of the main stem and branches is flabby.

The colour of the species is somewhat varied. In the present specimen the stalk is brownish-white ; the stem and principal branches yellowish-white with here and there dark red streaks appearing on the surface ; the smaller branches, twigs and polyps orange-red ; the polyp-tentacles white. In the original example the colour is white, the twigs and polyps of the lower half of the polyparium purple. In the specimen described by Hickson and Hiles the colour of the main stem, branches and polyp-heads is whitish, of the twigs purple. Whitelegge's specimen was, on the other hand, yellowish-white in colour, the twigs and polyps appearing red.

Locality : Table Island (Cocos), Andamans.

The species is previously recorded from Tahiti, 20-60 fathoms ; Sandal Bay (Lifu) ; Funafuti, 20 fathoms ; Kei Islands, 140 fathoms ; and Talili Bay (New Britain).

Dendronephthya orientalis, Henderson.

A large specimen, compact in appearance and much flattened, measuring 11 cm. in length and 7.5 cm. in breadth.

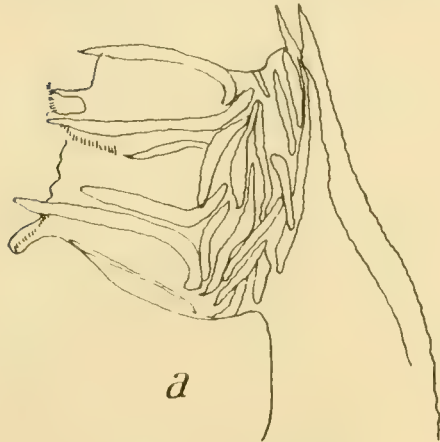


Fig. 16. *D. orientalis*.



Fig. 17. *D. orientalis*.—*b*, Spicules of stalk cortex; *c*, Spicules of stalk canal walls.

The stalk or trunk is short, thick, granular in appearance and leathery in texture, measuring 3.5 cm. in length, almost one-third of the total height, and furnished at the basal end with short stumps which may be the remains of stolons.

The polyparium is large, much flattened, somewhat regular in shape and roughly oval in outline. One side of the polyparium is flat and thickly covered with branches and polyps, while the other side is slightly rounded and more open. From the lower part of the main stem a number of small branches are given off; a little higher the stem gives off two large cylindrical branches, then rises entire for a considerable height, when it divides into two portions which are short and cylindrical in shape. From the whole surface of the main stem and branches smaller branches arise, and by divisions give rise to the twigs from which the polyp-stalks spring. These branches are on the whole cylindrical in shape in the lower part, often flattening a little at the point of division and giving off flattish smaller branches or twigs which lie more or less in one plane; or the lower part may be considerably flattened and the upper twigs branch in a plane which lies almost at a right angle to the lower portion. The lower branches, two in number, are flattened leaf-like structures; one is much larger than the other, and the two with their broad bases almost surround the stem, and being reflexed, form a collar hiding the upper portion of the stalk. From the upper surface of these branches smaller cylindrical branches arise. One of these arising from the larger flattened branch reaches considerable proportions. The main stem itself in its lower part is somewhat flattened in the plane of the polyparium.

The polyps are almost all on the surface, arranged in small bundles of

four to twelve individuals. They are placed at an angle which is usually right, but may be obtuse, on fairly long stalks, which may measure up to 2.5 mm. in length, but which on an average are considerably shorter. The groups on the lower part of the polyparium show a marked tendency to the divaricate type, but in the upper part they stand more closely together. On the edges and upper surface of the flattened lower branches the polyps occur singly or in small groups. The heads are rather large, being 0.9 mm. high and 0.65 mm. broad. The polyp-spicules are arranged in the following manner: the lower spicules, which measure from 0.33 to 0.51 mm. in length, are placed horizontally, above them rise eight pairs of large spicules which run practically parallel, being bent near the proximal end, the bent parts diverging; one of the pair is invariably larger than the other and projects further beyond the polyp, the smaller being often replaced by two still smaller spicules. In the spaces between adjacent pairs one or two small spicules are present, which in certain stages of the polyp's contraction or expansion may be parallel to the diverging parts of the large spicules. The latter measure from 0.48 to 0.9 mm. in length and may project to half their length beyond the polyp-head. The polyp-spicules are spindles, either straight or curved, and covered with regularly arranged blunt spines or thorns. On the aboral surface of the tentacles there are two rows of flattish toothed spicules, the ends of the spicules of the two rows interlacing in an irregularly alternate manner.

The Stützbündel is well developed, and contains several large spicules, one of which may measure 2.5 mm. in length, and project for a distance of 1.1 mm. Very frequently the tip of a second projects for a short distance. It is of interest to note the different stages in the growth of the Stützbündel, for in many of the smaller polyps it seems to be absent.

Cortical spicules: (*a*) In the main stem and branches there are spindles, straight or curved and covered with numerous blunt spines, regularly arranged. They vary in length from 0.42 to 2.5 mm. and in breadth from 0.072 to 0.18 mm. In addition there is a corresponding series of flatter spicules, much smaller in size and with fewer spines. In the principal stem and branches the spicules are arranged so as to produce a granular appearance, which gives way to a transverse stringy appearance only towards the tips, but in the smaller branches there is a distinct irregular meshwork of spicules arranged obliquely and transversely, and this continues up into the twigs.

(*b*) The stalk contains thick spindles, rods, ovals, clubs, triangles, globular and roughly four-sided forms, and a series of irregular spindle- to star-shapes. All except the last series are covered with numerous rough or branched warts, somewhat regularly arranged. The last series have equally prominent rough warts, but fewer in number and less regularly arranged. Many of the spindles are curved and show a greater development of warts on the convex side, and

many of the ovals and four-sided forms send out irregular somewhat flattened branches which may again branch. Some measurements are : Spindles 1.2 mm. \times 0.24 mm. ; rods 0.48 mm. \times 0.15 mm. ; clubs 0.42 mm. \times 0.21 mm. ; ovals up to 0.6 mm. \times 0.3 mm.

Canal-wall spicules : (a) In the stem are short, thick spindles, thickly covered with regularly arranged rough warts and measuring up to 1.5 mm. \times 0.3 mm. ; also a few small globular forms with fewer and less rough warts.

(b) Those of the stalk may be divided into two series, a rough and a smooth—the rough similar to the stalk cortical spicules, spindles, clubs, ovals, etc., the spindles measuring up to 0.8 mm. \times 0.18 mm.—the smooth series containing irregular, flat spindles, measuring 0.42 mm. \times 0.12 mm., irregular flat three- and four-rayed forms, oval and triangular forms, all of which may be greatly branched.

Colour—Stalk and principal branches dark brownish-grey ; stem and smaller branches a lighter shade of the same ; polyp-stalks and polyps reddish-brown ; tentacles greyish.

Locality : Andamans Coast, 13 fathoms.

Dendronephthya arbuscula, Henderson.

The colony is large, somewhat bush-shaped, mostly developed in one plane, with a long stalk, and measures 11 cm. in length and 8.5 cm. in maximum breadth.



Fig. 18. *D. arbuscula*.



Fig. 19. *D. arbuscula*.—From stalk cortex.

The stalk or trunk is long and rigid, granular in appearance, leathery in texture, measuring about 5.5 cm. in length, and having its upper part covered by the reflexed lower branches.

The polyparium is large, much flattened, with no regular outline owing to the arrangement of the principal branches. From the lower part of the stem

a number of smaller branches are given off. Immediately above this the stem gives off three main branches, one of which rises partly from the upper surface of one of the lower flattened branches; then it continues straight upwards for a considerable distance giving off only a short thick branch at one side. All the principal branches are thick and cylindrical in shape and give off from their surface a number of smaller branches, which directly, or by one or two divisions, give rise to the polyp-bearing twigs. The lower branches are flattened leaf-like structures which surround the stem, forming a sort of collar and hiding the upper part of the stalk. Two of them almost completely surround the stem, leaving only two small free spaces, and have their edges much convoluted, the free lateral surfaces curling upward towards the apex of the colony, thus forming a sort of triangular space over the free spaces. In these free spaces at a slightly lower level two smaller branches arise with cylindrical stalk and flattened upper portion which corresponds to the triangular space and is spread out in umbrella-like fashion.

The polyps are arranged, somewhat loosely, in small bundles of three to eight; the divergence of the polyps of a bundle is seen more markedly on the lower part of the polyparium. From the edge and from the upper surface of the flattened lower branches the polyps arise singly, or in small groups from twigs. The heads are small, measuring 0.54 mm. in height by 0.48 mm. in average breadth, and are placed on stalks of about 2 mm. in length at an angle which is usually obtuse. The spicules are arranged in eight double rows, in each of which there are five pairs of converging spicules; the uppermost pair are much longer than the others, run almost parallel, and project beyond the polyp-head. The lower spicules measure on an average 0.18 mm. in length, while the upper have an average length of 0.36 mm. and project 0.18 mm. On some of the younger polyps the difference between the upper and lower polyp-spicules is not so marked and the projection is not so apparent. On the aboral surface of the tentacles there are two rows of almost transversely placed, flat, toothed spicules which are thickly crowded together.

The Stützbündel is well developed, one of the spicules may reach a length of 1.5 mm. and project for a distance of 0.36 mm.; usually the tip of a second, and sometimes that of a third, may be seen projecting. Various stages in development can be seen, from cases where the Stützbündel is represented by a slightly larger spicule up to the complete form.

Cortical spicules: (*a*) The spicules of the stem and main branches are placed transversely, those of the smaller branches and twigs obliquely transversely or longitudinally. They are large spindles, straight or curved, and thickly covered with regularly arranged blunt to roughish spines. Several show bifurcation at the end. They vary in length from 0.33 to 3.4 mm. and in breadth from 0.06 to 0.24 mm.

(b) The stalk contains thick spindles, clubs, ovals, irregular three- and four-rayed forms, irregular three- and four-sided forms with sides slightly concave. All these are covered by prominent very rough warts more or less regularly arranged; the spindles are often much bent and sometimes show short branchings. Spindles measure up to 1.2 mm. \times 0.30 mm.; three-sided forms, 0.42 mm. \times 0.36 mm.; four-rayed, 0.54 mm. \times 0.30; clubs, up to 0.54 mm. \times 0.24 mm.; these often show a ridge of very prominent fused spines or warts on one edge. In addition to these there are a number of similar forms with few, and on the whole, simpler warts.

Canal-wall spicules: (a) The stem contains long slender spindles with regularly arranged blunt spines. They measure up to 2.4 mm. in length, and from 0.15 to 0.39 mm. in thickness.

(b) Those of the stalk include large, thick spindles, usually curved; three- and four-rayed forms with long, thick rays; three- and four-rayed forms with a short ray rising at an angle to the plane of the other two or three; tripod forms with a fourth ray at right angles to the other three; and small oval to globular forms. All these are thickly covered with prominent very rough warts which are usually branched. There is also a smoother series, with fewer and simpler warts, which vary from spindles to four-rayed forms. Spindles measure up to 2.2 mm. \times 0.42 mm.; three-rayed forms up to 1.7 mm. \times 1.2 mm.; four-rayed forms up to 1.8 mm. \times 1.3 mm. The rays of the three- and four-rayed forms are wider at the ends and may have a thickness of 0.42 mm.

Colour—Stalk dirty white; stem and branches greyish-white; twigs reddish-pink; polyp-stalks, varying from reddish-pink in lower part to yellow in upper part of the polyparium; polyps yellow.

Locality: Andamans.

Dendronephthya costatorubra, Henderson.

The colony is distinctly divaricate in type and is evidently a young specimen, measuring 30 mm. in height and 23 mm. in maximum breadth.

The stalk or trunk is slender and by no means rigid; it measures 13 mm., about half of the total height of the colony, and is characterised by its white semi-transparent appearance.

The polyparium is small, much flattened, and of no regular outline. It is formed of a number of branches which rise at an angle of about 45° to the main stem. Below these arise three flattened leaf-like branches or folds, which form a collar round the upper part of the stalk, leaving only three small open spaces two of which are opposite each other; directly below these two, two smaller branches arise, which have a cylindrical stem and a flattened upper portion, somewhat umbrella-shaped with the concave surface uppermost.

The polyps are arranged on elongated, diverging stalks in groups of four to five, young polyps arising often in the angle between two older polyp-stalks. They also occur singly on the edges of the lower branches. They are small,



Fig. 20. *D. costatorubra*.



Fig. 20A. *D. costatorubra*.—*b*, from stem cortex; *c*, from stem canal walls.

the length averaging 0.48 mm. and the breadth 0.6 mm. They are placed on the stalk at an obtuse angle, which often approaches very nearly to a right angle. They are roundish oval in shape, the long axis being parallel to the stalk. The younger polyps are much smaller on an average, measuring 0.27 mm. in length and 0.3 mm. in breadth. The spicules are arranged in eight double rows, in each of which there are four to five pairs of converging spicules. It is the exception for any of these to project beyond the polyp-head, but in one or two cases the uppermost project a very little. The spicules of the lateral rows are occasionally a little larger, but seldom project at all. The polyp-spicules are somewhat flattened spindles, straight or slightly curved, with simple spines; they often measure about 0.36 mm. in length, but are usually smaller.

The Stützbündel is well developed, consisting of two to three large, and a number of smaller spicules. One of the larger projects considerably, and very often a second also projects. In younger polyps the Stützbündel is not so pronounced but still is quite distinct, while in the youngest polyps its presence can be detected only from the fact that spicules are more numerous on the dorsal side of the short polyp-stalk.

Cortical spicules : (*a*) Those of the stem are slender spindles, straight or curved, 0.6 to 2.4 mm. long, 0.03 to 0.15 mm. thick. They form an irregular mesh-work, the smaller spicules lying in the larger meshes or running from one mesh to another. This arrangement is marked out by the presence of spicules either pink in colour or with a pinkish core.

(*b*) Those of the stalk are large spindles straight or curved, clubs, three-

and irregular four-rayed and rough star-shaped forms. They are all furnished with large prominent thorns, simple or compound. There are also short, curved spindles with huge thorns on the convex side, and irregular stars with few spines. The spindles may reach a length of 2.4 mm. and a breadth of 0.15 mm. The spicules are so arranged on the stalk as to produce a stringy appearance.

Canal-wall spicules: (a) In the stem there are a few small curved spindles, 0.27 mm. long and 0.024 mm. thick, and flat star- to spindle-shaped forms.

(b) The stalk has spindles, straight or curved, and often showing bifurcation at one end, three-rayed and a few four-rayed and irregular forms, some of which might be called incipient clubs. The spindles measure up to 1.03 mm. in length by 0.15 mm. in breadth.

Colour—Stalk white; stem yellowish-white marked with pink; terminal branches and twigs pinkish; the polyps appear red owing to their spicule colour.

Locality: Andamans.

Dendronephthya macrocaulis, Henderson.

This species is based on two specimens, in the larger of which the stalk is absent, and in the smaller the stalk is very short. The polyparium of the larger measures about 6 cm. in height and 6.5 cm. in greatest breadth.



Fig. 21. *D. macrocaulis*.

The stalk was apparently short and had its upper portion hidden by the reflexed lower branches. In the smaller specimen it is granular in appearance.

The polyparium is markedly flattened, irregular in outline and very loose and open, and is characterised by the enormously long polyp-stalks, which average a little over 5 mm. in length and often reach 8 mm. It consists of a number of principal branches each of which gives off other large branches which finally give rise to the polyp-bearing twigs. The principal branches are flattened in the

plane of the polyparium, and give off from all sides small branches which

give rise to the polyp-bearing twigs. The lower branches are flattened, leaf-like structures, two of which almost surround the stem. Below these there are a number of smaller branches with cylindrical lower and flattened upper portions. A majority of the smaller branches also show a slight flattening where they break up into the polyp-bearing twigs.

The polyps are arranged in small groups of three to five on widely divergent stalks, and also occur singly or in smaller groups on the edges of the large flattened branches. They are high, measuring about 1.2 mm. in height and 0.9 mm. in breadth, double cone-shaped and attached to the long (over 5 mm.) stalks by the apex of a cone. They sit at an angle which is very variable but approaches an obtuse angle, and the upper cone is incomplete. The spicules are arranged in the following manner: On the lower part there are a number of spicules arranged obliquely transversely, of which a few are strong, stout thorny spindles. Then there is a ring of horizontally placed spicules three to four deep, and above this rise eight points each consisting of one pair of converging spicules which are much larger than the lower polyp-spicules and project for a variable distance according to the state of retraction of the polyp. In the space between adjacent points a small spicule is always present, which lies more or less parallel to the larger spicules of the point. The lower polyp-spicules average about 0.35 mm. in length, the upper about 0.64 mm. On the aboral surface of each tentacle there are two rows of small rod-like spicules.

The Stütz Bündel is well developed, and consists of a number of spicules, two or three of which always project beyond the polyp. The spicules may reach a length of 2.4 mm.

Cortical spicules: (a) In the stem the spicules are long, slender spindles, either curved or straight and bearing numerous regularly arranged inconspicuous spines. The larger average about 3.7 mm. in length.

(b) In the stalk there are spindles, clubs and numerous irregular star-shaped forms, all having very prominent spines on the surface. The spindles average about 0.64 mm. in length.

Canal-wall spicules: (a) In the stem there are numerous very small disc-like bodies.

(b) In the stalk there are a few smooth flat striated spindle- to star-shaped spicules and numerous very minute disc-like bodies.

Colour—The stem, principal branches and smaller branches and twigs greyish-white; the polyp-stalks greyish-white in the lower part, yellowish in the upper; the polyps dark greyish.

Locality: Andaman Sea, 41-55 fathoms.

Dendronephthya andersoni, Henderson.

To this species is referred a colony which measures 8 cm. in height and about 5 cm. in greatest breadth.



Fig. 22. *D. andersoni*.

The stalk measures about 2.5 cm. in length and is greatly collapsed owing to the large size of the canals and the thin walls between them. It is granular in appearance, but just at its junction with the stem it becomes stringy.

The polyparium is loose, of no fixed shape owing to the irregular lengths of the branches, and is developed in one plane. The main stem gives off near its base two branches on opposite sides in the same plane, and then rises without any further branching to the tip where it divides into two. One of the lower branches is much larger than the other, thus giving a lop-sided development to the polyparium. Two of the lower branches are

flattened, reflexed, leaf-like structures which almost surround the stem, leaving only two small free spaces between their edges, below one of which arises a small branch with cylindrical lower portion and flattened concave upper portion, and directly above each open space there is a small flattened branch.

The polyps are arranged in groups of three to seven, and on the edges of the flattened branches they occur singly or in small groups. They are low, oval, measuring about 0.48 mm. in height and 0.8 mm. in breadth, and placed on the stalk (about 1 mm. long) at an obtuse angle. The spicules are arranged in eight double rows in each of which there are four to five pairs of converging spicules; the uppermost pair in each row are much longer than the others and project for a long distance beyond the polyp. The lower polyp-spicules average about 0.24 mm., the upper about 0.8 mm. in length and project for 0.48 mm. beyond the polyp. On the aboral surface of each tentacle there are two rows of small flat rod-like spicules.

The Stütz Bündel is well developed, and contains one or two spicules which measure up to 3.2 mm. and project for a short distance beyond the polyp.

Cortical spicules: (a) In the stem the spicules are large thick spindles, either straight, curved or greatly bent, and bearing numerous regularly arranged multituberculate warts. They average about 2.4 mm. in length and about 0.32 mm. in breadth. In addition there are small blunt spindles with few very simple warts.

(b) In the stalk there are spindles, clubs, three- and four-rayed forms, spindles with foliar expansions on one side, and numerous irregular spindles, globular and disc-shaped forms. All have very numerous large rough multituberculate warts and rough branched spines. The spindles average about 1.3 mm. in length.

Canal-wall spicules: (a) In the stem the spicules are long, straight, curved or sharply bent spindles with few regularly arranged simple multituberculate warts. They average about 2 mm. in length.

(b) In the stalk there are straight or curved spindles with numerous prominent multituberculate warts, smaller spindles, rods and three-rayed forms with fewer and somewhat simpler warts, and in addition a few simple spindles and branched forms which are somewhat flat and striated on the surface with few or no spines. The larger average about 1.7 mm. in length.

Colour—The stalk, stem and branches white to greyish-white; the twigs white with a reddish tinge; the polyp-stalks brownish-red; the polyps white.

Locality: Padaw Bay (Dr. Anderson).

Dendronephthya translucens, Henderson.

To this species we refer a single specimen from the Arakan Coast. It measures about 5 cm. in height and about 4 cm. in greatest breadth.

The stalk or trunk is short, about 1 cm. in length, thin-walled and stringy in appearance, and has its upper portion concealed by the reflexed flattened lower branches.

The polyparium is greatly flattened in one plane, irregularly oval in outline, and consists of a number of branches of unequal size. All round the stem and principal branches smaller branches are given off which give rise to the polyp-bearing twigs. Several of the lower branches are flattened, and two are flattened, leaf-like structures which almost surround the stem, leaving only two small spaces between their edges. Above these free spaces two small flattened branches arise. From the upper surface of the flattened leaf-like branches small ordinary branches are given off.

The polyps are arranged in small groups of about three each, and several of these groups are so arranged as to seem to form a larger group. On the edges of the flattened branches the polyps occur singly. They are low, measuring 0.4 mm. in height and 0.64 mm. in breadth, and are placed at a right angle on the stalks (about 1 mm. long). The polyp-spicules are arranged in the following manner: At the base of the polyp there are eight rows of one to two pairs of converging spicules, then a ring of horizontally placed spicules two to three deep, and then above these eight points each consisting of one pair of converging spicules. In each of the points there may be a third spicule which

lies alongside the larger of the two. The spicules of the point are larger than the lower spicules and project beyond the polyp. The lower spicules average about 0.24 mm. in length, the upper projecting spicules about 0.48 mm. On the aboral surface of each tentacle there are two densely packed rows of small rod-like spicules.

The Stützbündel is well developed, and consists of a number of spicules several of which measure 2.4 mm. in length and project for a considerable distance beyond the polyp.

Cortical spicules: (a) In the stem there are long slender spindles with very few inconspicuous spines, and averaging about 0.8 mm. in length.

(b) In the stalk there are spindles similar to those of the stem cortex, and averaging about 1.2 mm. in length, and a smaller series with much larger and more numerous spines.

Canal-wall spicules: (a) In the stem there are numerous very minute small discs or globular bodies.

(b) In the stalk there are numerous minute bodies similar to those of the canal walls of the stem.

Colour—The stalk is semi-transparent; the stem and principal branches bluish streaked with whitish spicules; the smaller branches whitish; the polyp-stalks and the polyps brown.

Locality: Arakan Coast, 13 fathoms.

Dendronephthya masoni, Henderson.

The colony is distinctly divaricate, measures 8.5 cm. high by 5 cm. wide, is flabby and flaccid, and presents no regular outline.

The short stalk measures about 1.5 cm. in length, has a granular appearance and gives off a few short blunt stolons at the base.

The polyparium is loose, very irregular, and flattened in one plane, the growth seeming to be more towards height than towards breadth. The stem first gives off a series of small branches, which have cylindrical stalks and flattened upper portions, the latter standing at a right angle to the stalks, in umbrella-like fashion. Above these, three leaf-like branches are given off and almost completely surround the stem, leaving only three small open spaces below which the first series of branches are more or less aggregated. The two larger of these branches almost surround the stem, while the third and smaller rises at a lower level. After a short distance the stem divides into three main portions which stand at an acute angle. These portions, in addition to giving rise by several divisions to small branches from which the twigs arise, give off similar small branches all over their surface, as does also the main stem.

The polyps are arranged in bundles of four to six, but six is the com-

monest number ; on the edge and also on the upper surface of the flattened branches, they occur singly or in small groups ; they are placed on a short stalk, the longest measuring fully 1 mm., at an angle which varies from acute to right but is usually right. Young polyps with practically no stalk arise at the base of and in the angles between the polyp-stalks. The heads are small, the larger measuring on an average 0.6 mm. \times 0.6 mm. ; others are only 0.45 mm. high and 0.66 mm. broad. The spicules are arranged in eight double rows of five to seven, but usually of six pairs each ; of each uppermost pair one may project for a very short distance. This may be seen more markedly in the lateral rows of the smaller polyps (the smallness of which may be due to their being greatly retracted).



Fig. 23. *D. masoni*.

There are two rows of spicules on the aboral surface of the tentacles. The polyp-spicules are flat spindles either straight or curved, with a few simple thorns ; they measure on an average 0.24 mm. in length, while the larger spicules reach a length of 0.36 mm.

The Stütz Bündel is well developed, consisting of five to six spicules which form a sheath for the back of the polyp-stalk and measure up to 3.6 mm. in length. One always projects for a considerable distance, about 1.05 mm., beyond the polyp, and a second projects for a very short distance in almost every case. The various stages of development of the Stütz Bündel can be well studied in this specimen—small spicules of equal size ; others similar, but more closely arranged ; slightly larger spicules which scarcely project ; and the complete form.

Cortical spicules : (a) The stem has slender spindles, straight or curved, with few small spines, and measuring from 0.48 to 3.75 mm. in length, and from 0.03 to 0.15 mm. in breadth. On the main stem and branches they are loosely arranged, at one part more transversely, at another more longitudinally, but always tending to become more regularly longitudinal towards the base of the smaller branches, on which they are more or less longitudinal in position.

(b) Those of the stalk include slender spindles similar to those of the

stem; large three-rayed forms with prominent warty projections, and rough huge spines at right angles; long curved spindles with prominent spines usually on one side, and with a large whorl at one end; but the majority of the spicules are small irregular forms which vary from spindles with huge spines and a whorl at one end to irregular multiradiate forms with similar whorls. The stalk has a granular appearance below, but in the upper part it approaches the stem in appearance.

Canal-wall spicules: (a) The stem contains long, slender spindles similar to those of the stem cortex.

(b) The stalk contains long spindles, usually curved, and having short simple spines; large, strongly curved spindles with prominent spines; irregular multiradiate forms with prominent simple or compound spines; three-rayed forms, either with short simple spines or with compound to warty protuberances; and flattened four-rayed forms with a few simple spines. The spindles measure up to 2.4 mm. and they often show a bifurcation at one end.

Colour—Stalk brownish-grey with a pinkish tinge; stem and principal branches a semi-transparent light brown; smaller branches and twigs a deep reddish-brown; the polyp bodies white; the tentacles very light brown.

Locality: Andamans (J. Wood-Mason).

Dendronephthya padavensis, Henderson.

This is a large specimen, about 7 cm. high and 6 cm. broad.

The stalk is very thick, about 1.5 cm. long, greatly collapsed and shrivelled, parchment-like in texture, granular in appearance, and gives off from its base a number of stolons.

The polyparium is very irregular in shape and of no definite outline. Its greatest development has taken place in one plane. The main stem rises for a short distance above the lower branches and then divides into two main portions which lie in one plane; one of these has scarcely developed while the other forms the chief part of the polyparium, and gives off several large secondary branches. All round the main stem and branches smaller branches arise which by repeated division give rise to the polyp-bearing twigs. Two of the lower branches on opposite sides of the stem are large, flattened, leaf-like structures which almost surround the stem, leaving only two small free spaces between their bases, and being reflexed form a collar to the lower portion of the stem. Directly below each of the free spaces a number of small branches arise, and two of these show a cylindrical lower portion, and a flattened upper portion, circular or triangular in shape and with a concave upper surface.

The polyps are arranged in small groups of about five each, and on the edge of the flattened lower branches they may occur singly. They measure

on an average 0.80 mm. in height and 0.75 mm. in breadth, and are placed at an obtuse angle on the stalk which averages about 2 mm. in length. The spicules are arranged in the following manner: At the base of the polyp there are eight double rows of two to three pairs of converging spicules which meet at an angle which varies from acute to obtuse; above these there is a ring of horizontally placed spicules, two to three deep, and above that rise eight double rows of one pair of converging spicules each. These double rows are a continuation of the lower double rows, and in addition to the one pair one or two other smaller spicules may be present which lie parallel to the larger spicules. The lower spicules average 0.4 mm. in length and the upper spicules, which project considerably, average 0.80 mm. On the aboral surface of the tentacles there are two rows of small, rod-like spicules.

The Stützbündel is not well developed, consisting of a few spicules which average about 0.9 mm. in length and of which one may project for a very short distance.

Cortical spicules: (a) In the stem there are curved or straight spindles of various sizes with numerous closely placed simple spines. The smallest average about 0.32 mm. in length, the middle about 1.2 mm., and the largest about 1.8 mm.

(b) In the stalk there are short spindles with rough branched spines and often a small foliar expansion at one end, irregular spindles, and numerous irregular star-shapes.

Canal-wall spicules: (a) In the stem are numerous small, flat spindle-to star-shaped forms with toothed edges; they average about 0.12 mm. in length.

(b) The spicules of the stalk are similar to the preceding.

Colour—Stalk, stem and principal branches white to semi-transparent; smaller branches white with yellowish twigs; twigs yellowish-brown; polyp-stalks brown; polyps whitish to colourless.

Locality: Padaw Bay (Dr. Anderson).

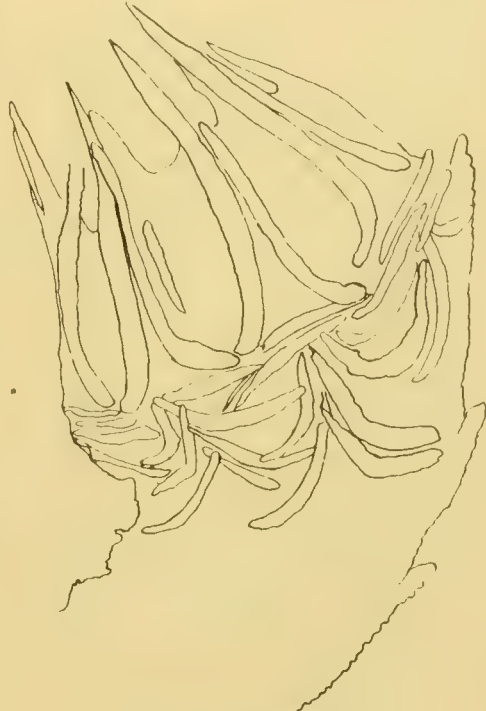


Fig. 24. *D. padavensis*.

Dendronephthya parvula, Henderson.

The specimen, which is undoubtedly young, has a short stalk and a very loose, irregular polyparium. The total length of the colony is 1.9 cm. and the maximum breadth is 2 cm.

The rigid stalk is short, measuring only 5 mm. in length. It has a sloping base of attachment as if it had been growing round some branch or rod-like structure. At the edge of its base one or two small stolons and the remains of a few others can be seen. Its upper portion is hidden, collar-wise, by the reflexed lower branches.

The polyparium is very loose and of no fixed shape, consisting of a slender stem and a few main branches which are all developed in one plane. From the slender stem two large branches are given off almost at the same level on opposite sides; the stem rises intact for a short distance, and then apparently divides into two portions, one of which is much larger than the other and has lost its tip. It may be that there are not two branches, but that the stem has been bent slightly to one side when the top branch was given off. Small branches arise from the main branches and from the surface of the stem. The two lowest main branches are flattened leaf-like structures and are reflexed, forming a collar to the upper part of the stalk. Their broad bases of attachment almost surround the stem, leaving only a small portion free.

Polyps may occur in groups of two to eight, most frequently of two, or they may occur singly on the ends of small branches, and they also occur singly on the free edges of the flattened, leaf-like branches. The polyps are roundish bodies, slightly longer than broad, measuring on an average 0.80 mm. in height and 0.64 mm. in breadth, and are placed on stalks, which measure up to 1.7 mm. in length, at an angle which is almost right but in a few cases becomes acute, owing to the polyp-head being slightly more bent towards the ventral surface. The spicules are arranged in the following manner: Round the base of the polyp they meet at a very obtuse angle, forming eight incomplete double rows in each of which there are one or two pairs of converging spicules; then there is a ring consisting of rows of horizontally placed spicules; above this rise eight groups of spicules, each group consisting of a curved spicule lying horizontally which forms a base for the triangle formed by the spreading ends of two upper converging spicules; a third spicule lies in the triangle thus formed, while another lies in the space between adjacent triangles. The upper pair of spicules, of which one is slightly longer, project for a considerable distance beyond the polyp. The projecting spicules are flattened spindles, either straight or curved, with numerous small spines; they measure up to 0.8 mm. in length, while the other polyp-spicules average 0.32 mm. in length. On the aboral sur-

face of the tentacles there are two rows of small, flat, blunt, rod-shaped spicules, with rough projections on the edges.

The Stützbündel is well developed, and consists of a number of spindles which may reach a length of 2.4 mm. and may project for a distance of 0.8 mm. beyond the polyp-head.

Cortical spicules: (*a*) Those of the stem are slender spindles, either straight or curved, covered with numerous small spines, and small, flattened, rod- or bar-shaped forms with very few small spines. The spindles vary in length from 0.4 to 1.6 mm. and in breadth from 0.032 to 0.08 mm. The rods or bars may reach a length of 0.24 mm. The spicules of the stem and branches give these parts a peculiar stringy appearance, very like newly chopped hay.

(*b*) Those of the stalk are spindles, shorter, thicker, and with rougher, more prominent spines than those of the stem. They are from 0.64 to 1.6 mm. long, and from 0.048 to 0.128 mm. broad.

Canal-wall spicules: (*a*) In the stem there are short thick spindles, straight or curved; a few three-rayed forms; a few four-rayed forms, and a large number of flat, smooth rods or bars, which have a number of fairly prominent blunt spines on their edges, and measure from 0.048 to 0.24 mm. in length and have an average breadth of 0.032 mm. The short thick spindles measure up to 0.80 mm. in length and 0.16 mm. in breadth.

(*b*) The stalk has small, smooth, flat, irregular spindles, and irregular, branched forms, all with sharp, prominent spines on the edges. They vary from 0.048 to 0.16 mm. in length.

Colour—Stalk greyish-white; lower part of stem whitish; upper part and branches violet-tinted, which gradually becomes more distinct as the smaller branches are reached; polyp-stalks light orange; polyps yellow.

Locality: Padaw Bay (Dr. Anderson).

Dendronephthya divaricata, Gray.

To this species we refer a bush-shaped colony which measures 4 cm. in height and 2 cm. in greatest width. The colony is rigid, nearly regular in outline and has a long slender stalk and a greatly flattened polyparium which is egg-shaped in outline.

The colour of the stalk is yellowish-pink, that of the stem and principal branches whitish-yellow, while the twigs and polyps are of a beautiful violet-pink colour.

Locality: Andamans.

This species has been previously recorded from New Guinea (the original type specimen), and from the Philippines (Kölliker).

Dendronephthya thuja, Henderson.

This species is represented by a rigid bush-shaped colony which measures about 5 cm. in height and 3 cm. in greatest breadth.

The stalk is thick and rigid, measuring about 2 cm. in length. It is granular in appearance and has a broad base of attachment, with no trace of stolons.

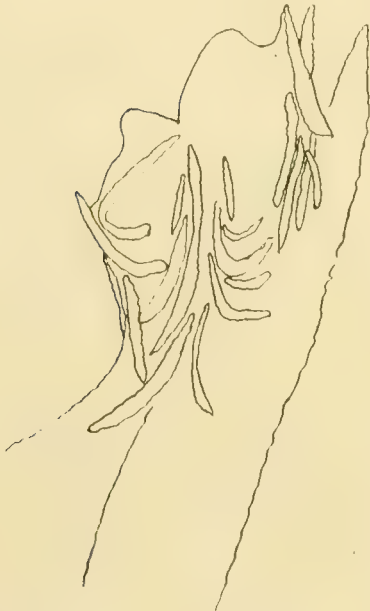


Fig. 25. *D. thuja*.

The polyparium is irregularly cylindrical in shape with a strong development of the branches all round except on one side, where there are very few branches. The stem rises entire, giving off branches of various sizes all round, which by their repeated divisions give rise to the polyp-bearing twigs. The two lowest branches are flattened, the larger being leaf-like and almost surrounding the stem, leaving only a small free space between its edges in which the second branch arises, the latter having a cylindrical lower portion and a flattened concave upper portion. From the upper surface of the flattened, leaf-like branch, small ordinary branches are given off. The leaf-like branch is also reflexed and thus forms a collar to the upper portion of the stalk.

The polyps are arranged in small groups of four to eight, and on the edge of the flattened branches they may occur singly or in small groups. They are small, roundish, and measure on an average 0.4 mm. in height and 0.4 mm. in breadth. The polyp-spicules are arranged in eight double rows of four pairs of converging spicules each, the uppermost pair being slightly larger and projecting a little beyond the polyp. The lower polyp-spicules average about 0.24 mm. in length, the upper about 0.4 mm. On the aboral surface of each tentacle there are two rows of small flat, rod-like spicules.

The Stützbündel consists of a number of spindles of about 0.9 mm. in average length which converge to a point and scarcely project beyond the polyp.

Cortical spicules: (a) In the stem there are thick spindles with numerous multituberculate warts and smaller slender spicules with few spine-like protuberances. The larger spindles average about 2.5 mm. in length and vary from 0.06 to 0.48 mm. in breadth.

(b) In the stalk the spicules are similar to those of the stem cortex but slightly smaller, and there are in addition clubs, oval-shaped discs and irregularly branched forms.

Canal-wall spicules: (a) In the stem there are a very few thick spindles similar to those of the stem cortex.

(b) In the stalk there are large thick spindles similar to those of the stem cortex, and in addition large three- and four-rayed forms, and a number of irregularly branched forms.

Colour—The stalk, stem and principal branches white; the smaller branches and twigs yellowish-white; the upper part of the polyp-stalk and the polyps deep brownish-red.

Locality: Off Ganjam Coast, 35 fathoms.

Dendronephthya rigida, Studer.

To this species we refer a specimen which measures 6 cm. in height and about 5.5 cm. in greatest breadth. It agrees in all the chief points with the descriptions given by Wright and Studer and by Kükenthal, the only differences being in the slightly larger size of the polyps and of the cortical spicules of the stem.

In the present example the colour of the stalk is brownish to greyish-black; the stem and principal branches greyish-black; the twigs are somewhat amber coloured; the polyp-stalks similar in colour to the twigs but with a slight tinge of red; the polyps white; the polyp- and tentacle-spicules red.

In colour the present specimen comes nearest *Spongodes (Dendronephthya) splendens* described by Kükenthal from the Moluccas.

Locality: Arakan Coast, 13 fathoms.

This species has been previously recorded from Japan; Ternate (Moluccas), 25 fathoms; Maldives; China; and the Cheval Paar pearl banks, Gulf of Manaar.

Dendronephthya microspiculata, Pütter.

To this species we refer a beautiful specimen from Gregory Islands, Mergui. The specimen measures 7.5 cm. in height and 6.5 cm. in greatest width. The lower part of the stalk is pinkish-white; the upper part white; the stem and principal branches a yellowish-white, with numerous short streaks of red; the smaller branches, twigs and Stützbündel purple-red; the polyps white.

Locality: Gregory Islands, Mergui Archipelago.

The species has been previously recorded from Amboina (Moluccas), Hong Kong and Philippines.

Dendronephthya microspiculata, Pütter, var. *andamanensis*, Henderson.

The colony is irregularly bush-shaped, flattened in one plane, of no regular outline, and measuring 8.8 cm. in height, 6.5 cm. in maximum width. It is

further characterised by the marked difference in the colour of the polyps on the main stem from that of those on the three large side branches.

The stalk is short, measuring 3 cm. in length, about one-third of the total height. It is thick and gives off from its base a number of short, thick stolons. It has a granular appearance and a leathery texture; the upper portion is covered by the reflexed lower branches.

The polyparium is much flattened, of no regular outline, having a ragged appearance owing to the branching arrangement. From the lower part of the stem a number of small branches are given off, from the stem next arise two large cylindrical side branches which stand almost at right angles. After a considerable distance the stem again gives off two side branches in the same plane as the former two; of these, however, one is larger and more cylindrical in shape, while the other is scarcely distinguishable from the small branches which rise from the whole surface of the stem and side branches. The small branches which arise from the main stem all show a slight flattening, while this is not so marked in the small branches of the main side branches. The lower branches of the stem are flattened, leaf-like structures, two of which practically surround the stem in collar-fashion, leaving only two small free spaces between them. Directly below these two open spaces rise two smaller branches with cylindrical bases and flattened upper portions which fill up the gaps between the edges of the two larger leaf-like branches. Directly above the free spaces two small branches with slightly flattened stalks arise.

The polyps are arranged in bundles of from three to seven individuals each, placed on stalks which diverge to a considerable extent. On the edge and on the upper surfaces of the flattened branches polyps occur singly or in groups. The polyps are small roundish bodies measuring 0.72 mm. in height and 0.66 mm. in breadth. They are placed at an obtuse angle on stalks which measure about 1.2 mm. in length, but which in some cases in the lower part of the polyparium may reach a length of 2 mm. The polyp-spicules are arranged in eight double rows each consisting of five to seven pairs of converging spicules. The second uppermost pair may be longer than the rest and project a little beyond the polyp-head. The polyp-spicules are spindles of about 0.30 mm. in length, the projecting spicules averaging about 0.48 mm. and projecting about 0.15 mm. beyond the polyp. They bear a fair number of simple spines which on the projecting part of the spicule are directed towards the tip. On the aboral surface of the tentacles two rows of flattened irregular toothed spicules lie closely packed together.

The Stütz Bündel is well developed, and consists of a number of spicules of which the tips of three or four project beyond the polyp. In most they average about 1.5 mm. in length, but others are 3.2 mm. long and project 0.8 mm.

Cortical spicules: (a) Those of the stem are spindles either straight or

curved, thickly covered with rough or branched warts, and measuring from 0.30 to 2.5 mm. in length, and from 0.09 to 0.21 mm. in breadth. They are arranged on the main stem and branches transversely, on the smaller branches longitudinally.

(b) The spicules of the stalk are spindles, rods, irregular clubs, three- and four-rayed, T- and L-shaped forms, globular forms with short processes and irregular oval to four-sided forms. All these are thickly covered with prominent rough or branched warts. In addition there are a few stringy almost smooth spindles and four-rayed forms. Spindles average 0.72 mm. \times 0.24 mm.; rods, 0.78 mm. \times 0.24 mm.; three-rayed, 0.66 mm. \times 0.42 mm.; four-rayed, 0.48 mm. \times 0.42 mm.

Canal-wall spicules: (a) Those of the stem are large spindles either straight or curved which are thickly covered with rough warts regularly arranged, and measure from 0.36 to 2.7 mm. in length and from 0.12 to 0.30 mm. in breadth. There are also three-rayed forms, 0.84 mm. \times 0.6 mm.

(b) The stalk spicules are very large and include spindles, three- and four-rayed forms, tripods, and twin four-rayed forms. They are all covered with numerous rough or branched warts which may approach blunt spines on some of the spindles. The spindles are either straight or curved, and often show bifurcation at one end. The rays of the three- and four-rayed forms are often very broad and flat. In addition there are numerous globular or irregular rough forms, smooth spindles, and irregular flattened three- and four-rayed forms. The first rough series measure as follows: Spindles, up to 1.8 mm. in length; three-rayed, up to 1.8 mm. \times 1.5 mm.; four-rayed, up to 1.2 mm. \times 1.02 mm.

Colour—The stalk is pinkish-white to white; the stem and principal branches are white; the smaller branches yellow; the twigs and polyp-stalks yellowish to yellowish with a tinge of red on the main stem; in the large side branches and tips of smaller branches the twigs and polyp-stalks are red; polyp-spicules and polyps white; tentacles white.

Locality: Andamans.

Dendronephthya mirabilis, Henderson, nec. *Spongodes mirabilis*, May.

The three specimens classed together here as *D. mirabilis* are all from the same locality in the Andamans. They show a considerable variation in size; the largest, which is greatly damaged, measures 9 cm. in height and 8 cm. in breadth; the second measures 7 cm. in height and 6 cm. in greatest breadth, while the third, which is a small specimen, is 2.5 cm. in height and about 2 cm. in maximum width. The following description is based on the two larger specimens:—

The colony is distinctly divaricate, bush-shaped, flattened in one plane and of an irregular oval outline, the long axis of which stands at an angle to that of the stalk.

The stalk is long, measuring in the larger specimen 4 cm. and in the smaller 3.3 cm. It is slender and flabby, delicate in appearance and with a finely granular surface.

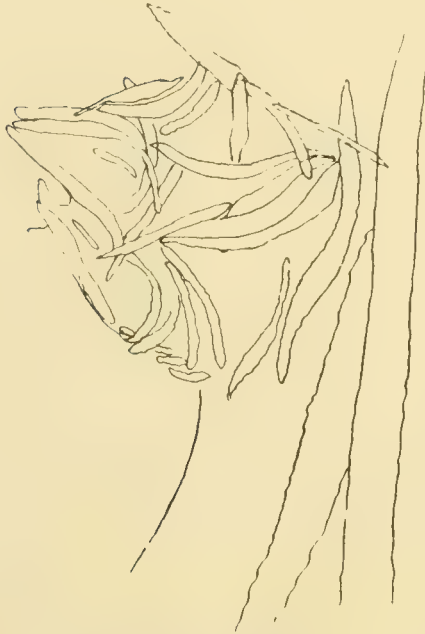


Fig. 26. *D. mirabilis*.

The polyparium is irregularly oval in outline and consists of several branches of unequal length. In the larger specimen the main stem divides into three prominent portions just above the origin of the lower flattened branches. Each of these main portions gives off a number of smaller branches which give rise to the polyp-bearing twigs. In the smaller specimen the stem rises a little above the origin of the flattened branches and then divides into two main portions which give off branches as in the larger specimen. The branches arise from the main portions at an acute angle. In the larger specimen the lower branches, two in number, are flattened, leaf-like structures which almost

surround the stem leaving only two small free spaces, and being reflexed surround the top of the stalk, in collar-like fashion. Directly below each of the free spaces a small ordinary branch arises. In the smaller specimen the lower branches are more or less flattened but do not form a collar.

The polyps are arranged in small diverging groups of six to ten, and are placed at an obtuse angle on stalks which measure on an average about 2 mm. in length, although many of the younger polyps have shorter stalks. They are cylindrical and form a sort of double cone with the wide basal portion forming the middle line of the polyp length, and the oral cone tapering more gradually than the basal one. They measure on an average 0.54 mm. in height and 0.6 mm. in breadth. The polyp-spicules are arranged in the following manner: At the base there are eight double rows in each of which there are two to three pairs of spicules meeting at an angle which varies from acute to obtuse but is usually obtuse; above this there is a horizontal ring of curved spicules two deep, and finally rising above this, in line with the eight double rows below, there are eight points each of which has one pair of spicules which meet at a very acute angle. Of the latter one is much larger than the other and may project for a considerable distance beyond the polyp. Alongside and

a little apart from the smaller there is usually a second spicule. On the aboral surface of each tentacle there are two rows of flat, blunt-toothed spicules which are placed horizontally, although just at the base of the tentacle they are arranged longitudinally. The lower polyp-spicules measure on an average 0.27 mm. in length, and the upper projecting spicules 0.66 mm. and may project beyond the polyp for a distance of 0.48 mm. although 0.3 mm. is the average.

The Stützbündel is well developed, and consists of a number of spicules which converge towards the base, while three or four project for a short distance. They average in the smaller polyps about 1 mm. but in the larger they reach a length of 3.2 mm. and project 1.2 mm. beyond the polyp.

Cortical spicules : (a) In the stem the spicules are long, slender spindles with simple regularly arranged spines. A few spindles blunt at one end and with slightly longer branched spines, and a few small three-rayed forms with blunt spiny projections are also present. The spindles vary in length from 0.35 to 3.0 mm. and in breadth from 0.03 to 0.15 mm. The spicular arrangement in the stem and branches suggests chopped hay, and this is continued more or less up to the smaller branches where the arrangement tends to become uniformly longitudinal.

(b) In the stalk the spicules are very varied, blunt spindles, clubs, curved spindles with a band of huge warts near the middle, irregular branched forms with three, four, five or more branches, and numerous irregular forms. All are characterised by the large number of huge simple or compound spines and large multituberculate warts.

Canal-wall spicules : (a) In the stem there are numerous flat, smooth spindle-shaped to star-shaped forms.

(b) In the stalk the spicules are similar to those of the canal walls of the stem with the doubtful addition of a very few small ordinary spindles.

Colour—The stalk, stem and branches are white to semi-transparent ; the twigs and polyp-stalks orange-yellow ; the polyps white.

Locality : Andamans.

The smallest specimen has two flattened, leaf-like branches which are reflexed and form a collar, and the polyparium is greatly flattened. This specimen agrees in all essential details with the two larger and is evidently a young specimen.

This new species belongs to the *rigida* group and is not far removed from *D. rosea*.

***Dendronephthya foliata*, Henderson.**

The colony is divaricate and presents a beautiful regular oval outline, the principal branches being of about the same size. It is 7 cm. high and 6.5 cm. broad.

The stalk is thick and fairly rigid, measuring 2·7 cm. in length and giving off a number of short stolons at the base.

The polyparium is large, much flattened, regularly oval, and presents a very compact appearance owing to the numerous small branches which raise all polyps more or less to the surface. It is further characterised by the great development of flattened branches at its lower end. At the upper end of the

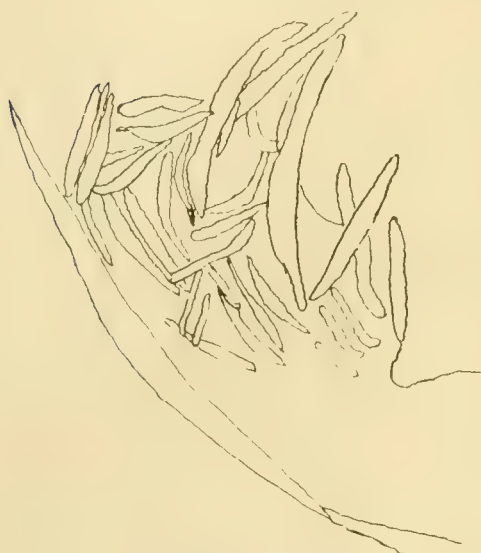


Fig. 27. *D. foliata*.

stalk two large flattened leaf-shaped branches or folds almost surround the stem, forming a collar to the upper part of the stalk and leaving only two small open spaces. They are very long, and the ends of the folds are curved upwards towards the apex of the colony. In the angle between them a smaller branch arises with cylindrical stalk and a flattened, three-cornered upper portion which stands at right angles to its stalk, the beautiful correspondence between its free edges and those of the larger neighbouring branches giving it an appearance somewhat like that of a bone suture. Above the small space on one side another flattened branch arises, but it is

reduced to a small narrow band, for directly above it two other flattened branches arise which come into contact almost above the middle of it. On the other side the single flattened branch is absent, there being only the two similar upper ones. Above this numerous branches are given off, filling out the regular oval.

The polyps are arranged in small groups, commonly of seven individuals, but occasionally groups of four and also of nine are found. On the edges and upper surface of the lower flattened branches they occur singly or in small groups of four to five. The polyps, which are placed at an obtuse angle on a stalk measuring about 1·5 mm., are low, egg-shaped bodies, slightly flattened, with an average height of 0·48 mm. and a breadth of 0·72 mm., the greatest breadth being dorso-ventral. The spicules are arranged in eight double rows, in each of which there are four to five pairs of converging spicules; the uppermost pair are of unequal size, the larger projecting beyond the polyp for a considerable distance. The spicules are flattened spindles, either straight or curved, with simple spines, which on the projecting part of the longest spicules are directed towards the tip. The lower spicules average 0·33 mm. in length, while the projecting spicules may reach a length of 0·72 mm. and may project for a distance of 0·39 mm.

The Stützbündel is well developed ; it consists of several spicules one of which may be 4·6 mm. long and project 1 mm. beyond the polyp. The tip of a second may also project slightly. Different stages can be well seen in polyps of different sizes. In the younger, the Stützbündel spicules are not very different from the others in size but their arrangement at once distinguishes them.

Cortical spicules : (a) Those of the stem are large spindles, either straight or curved, and one or two forms of spindles which have a thick part in the middle, then are abruptly narrowed and produced into a long, thin, tapering point. All are covered with regularly arranged spines or thorns which are simple in the smaller, but tend to become wart-like in the larger spicules. They vary from 0·36 to 5·0 mm. in length, and from 0·05 to 0·27 mm. in breadth. On the smaller the number of spines is relatively less than on the larger.

(b) The stalk contains short, thick spindles, thick clubs, globular forms, T-, Y- and L-shaped forms, irregular short spindles, and half-moon shaped forms, four-rayed forms, spindles with a short branch on one side, and balls with two arms going out at one side. All are characterised by the great development of the large warty protuberances which are on the whole regularly arranged. Spindles measure up to $2·0 \times 0·25$ mm., clubs up to $0·9 \times 0·27$ mm., globular forms up to 0·265 mm. The arrangement of the spicules on the stalk presents a fine granular appearance.

Canal-wall spicules : (a) The stem contains straight or curved spindles which may measure 1·8 mm. in length and 0·24 mm. in breadth and are covered with warty protuberances, and small, flat, smooth, spindle-shaped to star-shaped forms.

(b) The stalk contains very thick spindles, clubs, three-, four- and five-rayed forms, spindles which give off from one end three or four rays, peculiar hunch-backed spindles, and small, flat, smooth stars. All except the last-named are covered with prominent, regularly arranged, multituberculate warts. Spindles measure up to 2·1 mm. in length by 0·42 mm. in breadth, and some of the three-rayed forms measure 2·5 mm. in greatest length. In many of the four-rayed type one half is exactly the mirror image of the other half.

Colour—Stalk, stem and branches whitish-yellow ; upper surface of flattened branches white ; tips of the twigs, polyp-stalks, polyp bodies pale violet ; tentacles white.

Locality : Andamans.

Dendronephthya pentagona, Henderson.

To this species we refer a specimen from the Andamans, which measures about 6 cm. in height and about 5 cm. in greatest breadth.

The stalk is stiff and parchment-like in texture and measures about 2·5

cm. in total length. It is granular in appearance and shows traces of a few stolons at the base.

The polyparium is greatly flattened in one plane, roughly pentagonal in outline, and practically entire, showing no breaks on the surface. It consists



Fig. 28. *D. pentagona*.

of four principal branches which all lie in the same plane, two near the base of the stem, and the other two just at the tip. All over the main stem and branches smaller branches are given off, which by repeated division give rise to the polyp-bearing twigs, a slight flattening being occasionally seen at the point of division. Two of the lowest branches are flattened, leaf-like structures which almost surround the stem, leaving only two small free spaces, in each of which there is a small branch with a cylindrical lower part and a triangular flattened upper part concave above.

The polyps are arranged in groups of four to eight, and occur also in small groups or singly on the edges of the flattened branches. They are round in shape and

average 0.72 mm. in height and 0.72 mm. in breadth, and are placed at an angle which varies from right to obtuse on stalks of about 1 mm. in length. The polyp-spicules are arranged in eight double rows, each of five pairs of converging spicules, of which the uppermost pair are longest and project beyond the polyp. The lower polyp-spicules average about 0.24 mm. in length, the upper projecting spicules about 0.56 mm. On the aboral surface of the tentacles there are two rows of small rod-like spicules.

The Stützbündel is well developed, one of its spicules may reach a length of 3.2 mm. and project for a considerable distance beyond the polyp.

Cortical spicules: (a) In the stem there are numerous spindles either curved or straight with numerous blunt spines on the surface. They may be divided into two groups, the smaller averaging about 0.8 mm. in length, the larger about 2 mm.

(b) In the stalk there are spindles, clubs, three- and four-rayed forms and numerous irregular globular forms, all of which bear numerous regularly arranged prominent rough warts. There are in addition a number of forms which vary from flattened spindles to discs, and some roughly triangular flat plates which show a marked striation on the surface and are entirely free from warts or spines of any description. The spindles average about 1.4 mm. in length.

Canal-wall spicules: (a) In the stem the spicules are similar to the spicules of the cortex of the stalk, but differ in having fewer rough warts. The spindles average about 1.2 mm. in length and 0.28 mm. in breadth.

(b) In the stalk the spicules are similar to those of the canal walls of the stem, and in addition there are numerous spindles, three- and four-rayed forms, discs and plate-shaped spicules which are very flat, show a striated surface, and bear few or no spines. The stalk canal-wall spicules show every phase between blunt spines and simple warts.

Colour—The stalk, stem and branches are white; the twigs and polyp-stalks yellowish-white to brownish-red, white on the flattened lower branches; the polyps white.

Locality: Andamans.

Dendronephthya merguensis, Henderson.

The colony is small, measuring about 4.5 cm. in height and about 3 cm. in maximum width, much flattened, oval in outline, delicate in appearance.

The stalk is 1.8 cm. in height, nearly one-half of the total. It is very delicate but somewhat rigid, stringy in appearance. It gives off at its lower end a number of slender stolons and has its upper portion partly hidden by the reflexed lower branches.

The polyparium is much flattened and of regular oval outline, the long axis of the oval and that of the stem corresponding. From the lower end of the stem a number of small branches are given off, then two larger branches are given off almost at right angles a little above this, at slightly different levels on opposite sides of the stem and in the same plane. There is no more branching until a little below the apex of the colony, where the stem divides into two main portions which diverge so as to form almost a right angle between them. All these branches are cylindrical in form, and from their surface and the whole stem surface smaller branches are given off which by dividing once, or by repeated divisions, give rise to the short, thick twigs on which the polyps are borne. The lower branches are flattened, leaf-like structures which are reflexed and almost surround the stalk, in collar-like fashion, leaving two small free spaces; above each of these rises a small branch which shows a slight flattening.



Fig. 29. *D. merguensis*.

The polyps stand in small groups of six individuals on short stalks, the longest stalk measuring about 1 mm. in length. The individuals of a bundle do not diverge very much. The polyps are somewhat flat, measuring on an average 0.72 mm. in height and 0.78 mm. in breadth. They are placed at an obtuse angle on the stalk. The polyp-spicules are arranged in the following manner: Two to three pairs of spicules may meet at an angle or be practically horizontal, then above these one pair of converging spicules arises, one of which is larger than the other and projects beyond the polyp. Between adjacent pairs but always near the smaller of the two spicules lies another spicule of about half the size. The polyp-spicules are spindles with few simple spines, and measure 0.30 mm. in average length, the longer of the uppermost pair reaching 0.42 mm. and projecting 0.12 mm. Closely packed together on the aboral surface of the tentacles are two rows of flat, toothed spicules.

The Stützbündel is well developed; one spicule may reach a length of 3.3 mm. and may project 0.72 mm. beyond the polyp, but usually it is not so pronounced.

Cortical spicules: (a) The stem contains long, slender spindles, either straight or slightly curved, and sparsely covered by small spines regularly arranged. They measure from 0.9 to 2.4 mm. in length and from 0.06 to 0.15 mm. in thickness. They are more or less regularly transverse in position on the stem and main branches.

(b) Those of the stalk are slender spindles with prominent blunt warts, and smaller, smoother, irregular spindles. They measure on an average 1 mm. in length and 0.12 mm. in thickness.

Canal-wall spicules: (a) The stem has spindles, usually straight or slightly curved, stringy in appearance, and practically without protuberances. They average 0.42 mm. in length. There are also smooth, flat spindle- to star-shaped forms.

(b) Those of the stalk are similar to those of the stem, and in addition there occur a few three-rayed forms. The spindles differ, however, in having more numerous and more prominent spine-like protuberances, and average about 0.72 mm. in length.

Colour—The colony generally is white; exceptions are, polyp-spicules, tips of the twigs, and little patches here and there on the edges of the flattened branches, which are pale lilac, while a more distinct tinge of the same is seen in the polyp-stalks.

Locality: Forrest Strait, Mergui Archipelago.

Dendronephthya crystallina, Henderson.

The specimen is pear-shaped, regular in outline and somewhat flattened in one plane. It measures 4.3 cm. in height and 3.9 cm. in maximum width.

The stalk is short, and the long axis of the polyp-bearing portion stands at an angle to the stalk.

The stalk is short, measuring 1.2 cm. in length, somewhat thick and rigid, and gives off from its base and for a short distance up the side numerous stolons to which are attached fragments of shells and grains of sand.

The polyparium is pear-shaped and slightly flattened in one plane, and consists of a number of branches which rise almost at a right angle to the stem. The stem rises for a short distance entire, and then gives off a large branch on each side in the plane of flattening. Slightly farther up it gives off a second large branch on one side also in the plane of flattening. The larger branches rise at an angle which approaches a right angle, and give rise by repeated divisions to the small twigs which bear the polyps. Over the surface of the stem and branches smaller branches arise, which either bear the polyps themselves or give rise by division to the polyp-bearing twigs. Two of the lowest branches are leaf-like, flattened and reflexed, and almost surround the stalk, leaving two open spaces between the edges of their base of attachment, in which small ordinary branches with a rounded stem are found.

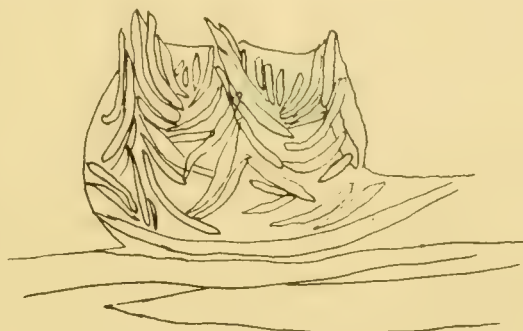


Fig. 30. *D. crystallina*.

The polyps are arranged in small groups of five to six, two or three of these being grouped together to form larger bundles. On the edge of the flattened, leaf-like branches the polyps occur singly or in small groups. The polyps are low, shallow, cup-shaped, measuring 0.4 mm. in height and 0.64 mm. in breadth. Each polyp sits at a right angle on a stalk which measures on an average 0.8 mm. in length. The polyp-spicules are arranged in eight double rows, in each of which there are five pairs of converging spicules. The upper pair in each row projects for a short distance beyond the polyp, and in the space between the double rows there are one or two pairs of short, thick spicules which run parallel to the sides of the adjacent double rows. The spicules are flattened spindles, either curved or straight, with minute spines on their surface. They measure on an average 0.24 mm. in length and 0.032 mm. in breadth; the projecting spicules, however, may reach a length of 0.4 mm. On the aboral surface of each tentacle there are two rows of small, flat, blunt spicules, arranged in bluntly converging pairs with their apices directed towards the distal end of the tentacles.

The Stützbündel is well developed, and consists of a number of large spicules which form a support for the polyp-stalk. The spicules may reach a

length of 2.8 mm. and one may project for a distance of 1.6 mm. beyond the polyp-head.

Cortical spicules: (a) In the stem the spicules are curved or straight spindles which often divide at one end into two or three branches or prongs which usually lie in close contact throughout their length. They are transparent, but the majority have a central axis of various shades of light-brown to brownish-pink. They measure up to 2.4 mm. in length and 0.16 mm. in breadth.

(b) In the stalk spindles, three- and four-rayed forms and numerous irregular forms are present, all of which are thickly covered by simple or branched spines. The spindles are either straight or curved and have the spines specially developed on one side, either running the whole length of the spicule or confined to a short tract on the side. They measure up to 1.36 mm. in length and 0.14 mm. in breadth, of which 0.064 mm. represents the length of the spines. The three- and four-rayed forms have in the centre an X-shaped marking. On the rays there are numerous large spines and in several cases one ray is more or less rudimentary.

Canal-wall spicules: (a) The spicules of the stem are represented by a very few small simple rods and three-rayed forms, and in addition by numerous small disc-like bodies. The rods measure up to 0.16 mm. in length and 0.0075 mm. in breadth.

(b) In the stalk the spicules are represented by numerous small disc-like bodies.

Colour—The stalk, stem and lower parts of the primary branches are translucent; the upper parts of the branches, twigs and polyps are purple; the tentacles translucent.

Locality; Unknown; Marine Survey.

Dendronephthya andamanensis, Henderson.

This species is represented by a single specimen which measures 5.5 cm. in height and 3.8 cm. in breadth. The exact shape of the polyp-bearing portion cannot be accurately determined, as the tips of the two upper branches are wanting.

The sterile stalk is long, 4 cm. in length, fairly thick and rigid, and gives off from its base a few slender stolons, and also one or two at a distance of 1.5 cm. from the base.

The polyparium is flattened and oval in form. From the lower part of the stem a few flattened branches are given off, and then the stem divides immediately into three cylindrical main portions, or rather gives off partly from its lower portion and partly from the upper surface of the flattened branches two main branches and then bends slightly to one side itself. From the surface

of the principal branches, smaller cylindrical branches are given off which by division give rise to the polyp-bearing twigs. Two of the lower branches are flattened, leaf-like structures, one of which, much larger than the other, almost surrounds the stem with its broad base, while the other with its smaller base fills up the remaining space, leaving only two small free spaces between its edges and the edges of the other. They are reflexed and form a collar to the upper part of the stalk.

The polyps are arranged in small groups of four to eight on widely divergent stalks, and singly or in small groups on the edges of the flattened branches. They are low and oval in shape, and are placed at a right angle on the stalks (2 mm. long), and average 0.55 mm. in height and 0.66 mm. in breadth. The polyp-spicules are arranged in the following manner: The lower polyp-spicules are either arranged horizontally, or there are three pairs of spicules which meet at an obtuse angle; then a ring of horizontally placed spicules three deep; surmounting this are eight points, each consisting of two or three converging spicules which project beyond the polyp. Of these converging spicules one is much larger than the other, or others, for it is often opposed by two. In the space between the adjacent points there lie two smaller spicules of about 0.15 mm. in length which are parallel to the converging spicules, one lying usually close beside the larger projecting spicule. The lower polyp-spicules average 0.33 mm. in length, the upper converging spicules measure about 0.45 mm. and project from 0.24 to 0.3 mm. beyond the polyp. On the aboral surface of each tentacle there are two rows of small rod-like spicules.

The Stützbündel is well developed, and has one or two spicules projecting beyond the polyp, and sometimes the tip of a third may also be seen. These spicules measure about 2.8 mm. in length and project for a distance of 0.84 mm. Often the Stützbündel is not so well developed, but this is undoubtedly a younger stage. The arrangement of the spicules on the polyp-stalks is worthy of notice. Along the ventral side there is a dividing line, and from this the spicules are regularly arranged obliquely and transversely, sloping towards the tip on each side.

Cortical spicules: (a) In the stem there are long spindles with numerous regularly arranged rough warts. They are either straight or curved, often with a bifurcation at one end, and vary from 0.42 to 3.0 mm. in length and



Fig. 31. *D. andamanensis*.

from 0.04 to 0.21 mm. in breadth. There are also some smaller spindles with very few and simple thorns.

(b) In the stalk there are long, curved or straight spindles with very regularly arranged prominent and often branched warts. They sometimes give off a short branch about the middle of one side, and vary in length from 0.3 to 2.4 mm. and in breadth from 0.12 to 0.21 mm.

Canal-wall spicules : (a) In the canal walls of the stem there are spindles with numerous regularly arranged prominent warts on their surfaces. They vary in length from 0.9 to 1.2 mm. and average about 0.15 mm. in breadth. In addition there are a few spindles, stringy or pitted in appearance, with few protuberances or none, and averaging about 0.27 mm. in length and 0.03 mm. in breadth.

(b) In the stalk there are curved or straight spindles, with numerous more or less regularly arranged branched warts on the surface, a few clubs and a number of irregular star-shaped forms, all bearing rough warts similar to those on the spindles. In addition there are flat, smooth spindle-shaped to star-shaped forms. The spindles average about 1 mm. in length and 0.15 mm. in breadth.

Colour—The stalk is yellowish in its lower portion, yellow-white above; the stem and principal branches white with a tinge of yellow; the smaller branches and twigs yellowish; the polyp-stalks and polyp-spicules rose-coloured; the tentacles white.

Locality : Andamans.

Dendronephthya persica, Henderson.

The specimen is large, measuring 6 cm. in height and almost 5 cm. in maximum width. The stalk is short and the polyp-bearing portion is greatly flattened in one plane and fairly compact in appearance.

The stalk or trunk is about 1 cm. in length, and has its upper portion hidden by the reflexed flattened branches. It is thick and much wrinkled and has a flat base of attachment from the edges of which a few stolons are given off.

The polyparium is regularly oval in outline, compact in appearance, and consists of a number of branches of about equal length. From the lower part of the stem a few small branches are given off, and then above this two branches are given off in the same plane, at slightly different levels on opposite sides of the stem. Of these branches one is much larger than the other, and above their origin there is no division of the stem into main branches. The lower branches are flattened, fold-like or leaf-like structures, two of them being much larger than the rest, and almost surrounding the stem, leaving only a small free space between the edges. In the free space on one side two small

branches with cylindrical lower portion and flattened umbrella-like upper portion arise and fill up the space ; in the other free space there is only a single branch similar to these two. From the upper surface of the flattened folds and partly from the stem there arise two cylindrical branches which stand at an acute angle to the stem, and are of considerable size. From the surface of the stem and larger branches smaller branches are given off at right angles to the surface ; these are cylindrical, and by repeated divisions give rise to the polyp-bearing twigs. At the point of their first division a slight flattening occurs, and in most cases this is continued throughout all the divisions.

The polyps are arranged in small groups of four to eight, and stand on stalks which measure up to 2 mm. in length. They are more or less divergent, but this is partly concealed by the young polyps, and thus the arrangement approaches that of the *Umbellatae*. On the edge of the flattened branches the polyps occur singly or in small groups. They are low and rounded, measuring 0.48 mm. in height and 0.72 mm. in breadth, and are placed at right angles to the stalk, but at times seem to be at an acute angle owing to the head being slightly more bent down. The spicules are arranged in the following manner : about two pairs of polyp-spicules converge, then comes a girdle of horizontally placed spicules three to four deep, and above this rise eight points each consisting of one pair of acutely converging spicules which are unequal in length, and project for a considerable distance beyond the polyp. A third spicule is often present and lies usually parallel to the smaller of the two. The two projecting spicules run almost parallel, diverging only near their base where they are sharply bent, and in the space thus formed between their bent portions and the horizontally placed spicules, there may be a small curved spicule with the convex side upwards. Another spicule occurs in the spaces between the points. The lower polyp-spicules measure about 0.25 mm. in length, while the upper projecting spicules average about 0.6 mm. in length. On the spicules numerous thick blunt spines occur at right angles to the surface, but on the projecting portion of the spicule they are directed obliquely towards the tip. On the aboral surface of each tentacle two rows of densely crowded flattened toothed spicules are present.



Fig. 32. *D. persica*.

The Stützbündel is markedly developed, the larger projecting spicule giving the colony a spiny appearance, and making it decidedly prickly to the touch. The spicule may reach a length of 4.8 mm. and project for a distance of 1.2 mm. beyond the polyp.

Cortical spicules : (a) In the stem the spicules are arranged transversely, but become longitudinal in the smaller branches and twigs. They are spindles either curved or straight, and closely covered by regularly arranged rough warts ; they vary from 0.6 to 2.7 mm. in length and from 0.06 to 0.36 mm. in breadth. In addition there are smaller spindles and three-rayed forms, somewhat stringy in appearance and with fewer and simpler protuberances.

(b) In the stalk there are spindles, clubs, irregular three- and four-rayed forms, globular forms and irregular spindles. All are thickly covered by very rough or branched warts, and in addition on many spindles and other forms alike there are very long branched thorns. The spindles measure from 0.27 to 0.92 mm. in length and from 0.09 to 0.25 mm. in breadth. In addition there are a few spindles much smaller in size, with fewer and more spine-like protuberances, and with a striated surface.

Canal-wall spicules : (a) In the stem there are small, flat, smooth spindle-to star-shaped forms and more irregular stars.

(b) In the stalk the spicules are slightly larger than in the stem, and are irregularly branched, flat and practically smooth forms, triangular forms and irregular stars. They have an average length of 0.30 mm. and a breadth of 0.18 mm.

Colour—The whole colony is dirty greyish-white.

Locality : Persian Gulf.

Dendronephthya dichotoma, Henderson.

The colony is distinctly divaricate in type ; the shape is that of a bush, and the outline a regular oval, the long axis of the oval being at an angle to the main stem. It measures about 9 cm. in height and about 7 cm. in breadth.

The short, stout stalk measures about one-half of the total length ; its upper part is concealed by reflexed flattened branches ; it is granular in appearance, gives off at its lower end a number of short, blunt stolons, and has an outer coating of large, rough spicules for a short distance up from its lower end.

The polyparium is large and obliquely oval in shape, and is formed in the following manner : The main stem gives off flattened, leaf-like branches, continues for a short distance entire, and then divides into two main portions one of which again divides into two main branches. From the surface of the main stem and branches smaller branches are given off more or less at a right angle,

and these again divide in a roughly dichotomous manner into smaller branches or twigs which bear the polyps. The arrangement of the leaf-like branches is noteworthy—both are very large and form a collar almost surrounding the stem, leaving only two small spaces, at each of which a much smaller branch arises at a slightly lower level; but these smaller branches, although appearing leaf-like owing to their flat upper portion, have an almost cylindrical lower portion, in contrast to the two larger branches whose origin is almost as broad as the flattened portion and which may be called well-developed folds of the outer surface. Smaller branches are given off from the upper surface of these, as from the stem and its main branches.



Fig. 33. *D. dichotoma*.

From the ends and sides of the twigs and from the edges of the flattened branches the polyps arise in small bundles of three to eight individuals and are placed on widely diverging stalks. The divaricate nature of the bundles tends to be masked

by young polyps which arise at the base of a polyp-stalk or in the angle between two stalks. A noteworthy feature is that there are apparently two kinds of polyps, (i) a larger with very well-developed Stützbündel, and (ii) a smaller, with a weak Stützbündel or with none. This apparent dimorphism is simply due to the juxtaposition of adult and young polyps. The polyps are small, measuring on an average 0.45 mm. long and 0.45 mm. broad, and are placed practically at a right angle on the stalk, which is slightly less than 1 mm. in length. The polyp-spicules are arranged in eight double rows in each of which there are five pairs of converging spicules, one or both of the uppermost pair being longer, and, especially in the lateral rows, projecting beyond the polyp-head. The lower spicules are 0.30 mm. long, while one or both of the uppermost pair may reach a length of 1 mm. and project for a distance of 0.6 mm. All these have short, simple, regularly arranged thorns, which on the projecting tips show a tendency to upward direction.

The Stützbündel spicules are enormously developed and form a shield for the back of the polyp-stalk. They are usually four to five in number, one of which is generally especially long; the longest may reach a length of 4 mm. and a breadth of 0.18 mm. and project for a distance of 1.2 mm., but the average

length of the prominent spicule is about 3 mm. with a projection of 0.6 mm. In most cases a second spicule projects; this is best seen among the younger polyps, but it occurs in most of the others also.

Cortical spicules: (a) Those of the stem are spindles, almost always slightly curved and thickly covered by rough prominent warty protuberances. They vary in length from 0.54 to 4.5 mm. and in breadth from 0.039 to 0.08 mm. They are quite visible to the naked eye, and form a rigid armature. Some of the smaller have simple spiny protuberances. The spicules lie obliquely transverse on the main stem and branches, but are almost perfectly longitudinal on the smaller branches and polyp-stalks.

(b) In the stalk there is a much greater variety of spicules. In addition to long spindles similar to those of the stem but with simpler warty protuberances, there are short thick clubs with rough warts, others with foliar expansions at one end, short thick spindles with a foliar expansion about the middle of one side, small roughly spherical bodies with rough warts, incipient three- and four-rayed forms, and other very irregular forms. The arrangement produces a markedly granular, one might almost say a pebbly appearance, which is broken only here and there by a few large spindles appearing on the surface. The spicules vary much in size; some average measurements are: longer spindles, 3 mm. in length; clubs, 0.55 mm. \times 0.25 mm.; spindles with foliar expansion, 0.7 mm. \times 0.30 mm.

Canal-wall spicules: (a) The stem contains spindles, either straight or considerably curved, and covered either with rough warts or with spines. There are also many very small smooth spicules varying in shape from flattened rods with prominent spines to branched forms of the same, and three-rayed forms. The large spindles are from 0.65 to 4.5 mm. long and from 0.06 to 0.6 mm. broad; the three-rayed average 0.6 mm. \times 0.36 mm.; the small spicules are up to 0.105 mm. in length.

(b) Those of the stalk are large spindles, either straight or curved, small clubs, three- and four-rayed forms and incipient four-rayed forms. Most of these are characterised by a thick coat of very rough warty protuberances, while a few are not so thickly covered and have simpler protuberances.

Colour—The stalk, stem and branches are white; the polyps brick-red, although a tinge of yellow is visible in some parts of the smaller branches and in the polyp-stalks.

Locality: Ganjam Coast, 15-25 fathoms.

Dendronephthya ganjamensis, Henderson.

The colony is bush-shaped and consists of a short stalk and two main branches. It measures 7 cm. in height and 6 cm. in maximum breadth.

The stalk has been considerably damaged, but is short, thick, rigid, leathery in texture, somewhat granular in appearance and gives off a few stolons. Its upper portion is hidden by reflexed branches.

The polyparium has been cut and it is difficult to determine its original shape. It is flattened in one plane and consists of two main portions, each of which has a somewhat bottle-brush appearance. From the lower part of the stem a few branches are given off; above this the stem may be considered either to divide into two main portions, or to give off at one side, at an angle of 45° to itself, a large cylindrical branch which has had a strong development. This point is rather difficult to determine as the stalk and stem have been split up for a considerable distance on one side, but the latter alternative seems the more probable. From the surface of the main stem and branch small cylindrical branches are given off in every direction, which by repeated division give rise to the polyp-bearing twigs. The lower branches, three in number, are flattened, two of them being leaf-like, and almost surrounding the stem, leaving only two small spaces, in one of which, at a slightly lower level, a small branch arises with cylindrical lower part and flattened upper umbrella-like portion, the concave side being uppermost. It is more than probable that a corresponding branch would have been found at the other open space had the stalk and lower part of the stem not been destroyed by a long cut. The lower branches, being reflexed, form a collar which hides the upper part of the stalk.

The polyps are arranged in small groups of three to seven individuals each, but five is the commonest number. The polyp is placed on a stalk about 1 mm. long. The stalks of a group diverge considerably in all parts of the polyparium. The polyps, which measure about 0.6 mm. in height by 0.6 mm. in breadth, are placed on the stalks at an obtuse angle. The polyp-spicules are arranged in eight double rows of from six to seven pairs of converging spicules each. One of each uppermost pair may be much larger and have one spicule projecting far beyond the polyp. The lower polyp-spicules measure on an average 0.33 mm. in length, while the large projecting spicule may reach a length of 0.90 mm. and project a distance of 0.30 mm. This large spicule is paired with a



Fig. 34. *D. ganjamensis*.

spicule of about 0.30 mm. in average length. These spicules have regularly arranged simple spines which on the projecting part of the large spicule are directed towards the tip. On the aboral surface of the tentacles two thickly crowded rows of small, flat, irregularly toothed spicules are present.

The Stützbündel is well developed; one or two of the spicules may reach a length of 4.2 mm. and may project 1.2 mm. beyond the polyp-heads. On many polyps, however, the Stützbündel is much less pronounced.

Cortical spicules: (a) Those of the stem are huge spindles either straight or curved, thickly covered with regularly arranged rough or branched warts. They vary much in size, measuring from 0.48 to 8.5 mm. in length and from 0.09 to 0.6 mm. in thickness. In addition there are small spindles with fewer and simpler warts or spines. The arrangement of the spicules on the main stem and branches is irregularly transverse, while in the smaller branches and twigs it is almost perfectly longitudinal, giving a very firm support to the whole colony.

(b) The stalk contains thick spindles, rods, clubs, oval and globular forms. The spindles are either straight or curved, and measure from 0.3 to 2.4 mm. in length and from 0.12 to 0.36 mm. in breadth. In addition there are a few more irregular forms. All are thickly covered with regularly arranged warts which are usually branched.

Canal-wall spicules: (a) Those of the stem are large spindles measuring from 0.30 to 3.6 mm. in length and from 0.12 to 0.78 mm. in thickness.

(b) In the stalk are large spindles, three- and four-rayed forms, and a very few tripods. The spindles may be straight, curved, or much bent, often forming a shallow V-shape; the three-rayed forms are large and have long rays; the four-rayed might be called irregular three-rayed with one ray branched; the longest ray of the tripod rises at right angles to the others. Many of the spindles show a short branch and are often toothed or much branched at one end. They are all thickly covered with rough, usually branched, warts. Spindles average 3.0 mm. \times 0.42 mm.; three-rayed, 2.1 mm. \times 1.2 mm., the rays averaging about 0.42 mm. in thickness; four-rayed, 2.4 mm. \times 1.5 mm. In addition there are small, flattened, irregular spindle-shaped and rayed forms.

Colour—Stalk, stem and branches white, the smaller branches show a tinge of yellow; twigs yellowish, with scattered pink spicules; polyp-stalks pink; polyp-spicules pink; tentacles white.

Locality: Off Ganjam Coast, 35 fathoms.

Dendronephthya longispina, Henderson.

The specimen is distinctly divaricate, and measures 5.6 cm. in length and 5.2 cm. in maximum breadth.

The stalk is short and thick, measuring 13 mm. in length, and has a broad base of attachment. It is granular in texture, but there is a series of larger spicules more or less regularly arranged on the surface, giving it a peculiar stringy appearance. Its upper portion is hidden by reflexed lower branches.

The polyparium is regular in outline, roughly four-sided in shape, and greatly flattened in one plane. The lower branches are flattened, leaf-like or ridge-like structures. Two of them are very large, practically surrounding the stem, their free ends overlapping where they meet. They are reflexed and form a collar to the upper part of the stalk; they have broad bases of insertion which leave two very small spaces between them; directly above this space at each side there arises a small branch, flattened in its upper, but more rounded in its lower portion. Almost immediately above this the stem gives off two large branches, and after rising for a short distance entire, divides



Fig. 35. *D. longispina*.

into two large branches. These four large primary branches repeat the structure and branching arrangement of the stem, though in a less marked degree. At the base of one of the two lower primary branches there is an arrangement of flattened, leaf-like branches similar to those on the stem, though rather less developed. From the upper surface of each of the largest lower flattened branches a small branch is given off which repeats the structure of a large primary branch. All over the surface of the stem and primary branches small secondary branches arise at an angle which is practically right, and by their division give rise to the twigs on which the polyps are placed.

The polyps are arranged in small groups of three to five, on widely diverging stalks, the appearance of the colony thus becoming very open. On the leaf-like branches the polyps occur singly on the edge or in small groups on the upper surface. It is difficult to determine the exact number of some groups as there is often a polyp standing directly in the angle formed by two polyp-bearing twigs. The heads, low, oval, 0.56 mm. high, 0.64 mm. broad, are placed at an obtuse angle on a stalk which may be 2.5 mm. long, but which varies considerably in length. The spicules are arranged in the following manner: There are eight double rows of spicules; in each double row at the base of the polyp there are two pairs of converging spicules; then comes a ring of two rows of

transverse spicules; between the double rows, directly below the transverse spicules, lie two curved spicules, concave side upwards; above the ring of transverse spicules rise eight points each consisting of at least one pair of converging spicules, of which one is much larger and projects considerably; in addition there is a single curved spicule lying between adjacent uppermost pairs and so placed that it appears to strengthen the basal attachment sometimes of the larger and sometimes of the smaller. The converging pair run practically parallel for a considerable distance, and in the divergence at their base there is sometimes an extra spicule which lies close to and runs parallel to the basal portion of the larger spicule. The spicules are flattened curved spindles from 0.16 to 0.30 mm. long and averaging 0.017 mm. in breadth. The projecting spicule may measure up to 1 mm. in length and may project for a distance of 0.48 mm. beyond the polyp-head. On the aboral surface of each tentacle there are two rows of smooth flat rods, the inner ends of which alternate more or less regularly with one another, being thickly crowded together. They have an average length of 0.021 mm.

The Stützbündel is moderately developed and consists of a number of spicules which measure about 2 mm. in length. One projects for a short distance beyond the polyp.

Cortical spicules: (*a*) In the stem there are slender spiny spindles straight or curved, varying from 0.04 to 2.9 mm. in length.

(*b*) In the stalk there are slender spindles straight or curved, thickly covered by spines, irregular three- and four-rayed forms and a number of irregular forms with prominent irregular or branched spines; there are also smoother, flattened forms with a few blunt spines. Spindles vary from 0.24 to 2.4 mm. in length and from 0.032 to 0.176 mm. in breadth. The rayed forms may reach a length of 0.4 mm. The irregular forms are irregular clubs or spindles with a large number of prominent spines aggregated at one end. The small, smooth forms vary in length from 0.064 to 0.16 mm.

Canal-wall spicules: (*a*) Those of the stem are similar to those of the stem cortex, and in addition there is a number of irregular forms with rough spines. Spindles may reach a length of 0.9 mm. and a breadth of 0.112 mm.

(*b*) Those of the stalk are smooth, flattened, three- and four-rayed forms, numerous irregular branched forms, and a number of spindles straight, curved, or irregularly sigmoid, with pointed or blunt ends. On the surface of each spicule there are scattered a few inconspicuous smooth rounded warts or blunt spines. Spindles may reach a length of 0.64 mm. and a breadth of 0.08 mm. The rayed forms have a maximum length of 0.560 mm.

Colour—The larger spicules of the stalk are opaque white in the central portion, otherwise the stalk appears greyish-white; stem and branches greyish-white; polyp-stalks and heads light cinnamon-brown.

Locality: Andamans.

Dendronephthya arakanensis, Henderson.

A large specimen measuring 8 cm. in total height and about 6 cm. in greatest width.

The stalk is thick and flabby, and about 3.5 cm. long; it is granular in appearance and shows slight traces of stolons at the base; its upper portion is hidden by reflexed flattened branches.

The polyparium is regular in outline, oval in shape and greatly flattened in one plane. It is compact in appearance and has an almost unbroken surface, the numerous branches standing in close contact with one another. Several large branches are given off in the plane of flattening, arranged in pairs on opposite sides of the stem. The two lowest branches are flattened, leaf-like structures which practically surround the stem; they are reflexed and completely hide the uppermost third of the stalk. From the upper surface of each and partly from the stem a large ordinary branch is given off. All over the surface of the stem and larger branches small secondary branches are given off which by repeated division give rise to the polyp-bearing twigs.

The polyps are arranged in small bundles of five to ten, seven and eight being most usually met with, and may occur singly or in small groups on the edges of the flattened branches. They are roundish, 0.48 mm. high, 0.64 mm. broad, and are placed almost at right angles on the long stalks which measure about 1.2 mm. The spicules are arranged in the following manner: At the base of the polyp there are one to two pairs of converging spicules; then there is a ring of horizontal spicules about three deep, and above this rise eight points in each of which there is one pair of large spicules, one being slightly longer than the other and projecting; occasionally a third spicule is found lying alongside one of this pair. The lower polyp-spicules average 0.22 mm. in length, the upper 0.4 mm. They are spindles with regularly arranged spines which on the projecting part are directed obliquely towards the tip. On the aboral surface of the tentacles there are two rows of small rod-like spicules.

The Stützbündel is well developed, and consists of a number of spicules one of which may reach a length of 1.2 mm. and project a distance of 0.6 mm.



Fig. 36. *D. arakanensis*.

Cortical spicules : (a) Those of the stem are spindles, straight or curved, averaging about 0.48 mm. long, with regularly arranged simple spines ; also a few irregularly branched, flat, smooth, striated forms.

(b) Those of the stalk are short, thick spindles, which average about 0.30 mm. in length, clubs, tripods, discs, three-rayed and globular forms, and numerous irregular forms including variously shaped twins.

Canal-wall spicules : (a) In the stem there are numerous smooth, flat, spindle- to star-shaped forms with toothed edges.

(b) Those of the stalk are similar to the preceding.

Colour—Stalk greyish ; stem, main branches and lower parts of secondary branches pinkish-grey ; upper parts of branches and twigs brown ; polyps yellowish-brown.

Locality : Arakan Coast, 13 fathoms.

Dendronephthya delicatissima, Henderson.

This species is represented by a beautiful specimen which measures 5.1 cm. in height and has a maximum breadth of 4.7 cm. The colony is remarkable for its fine contrasting colours.

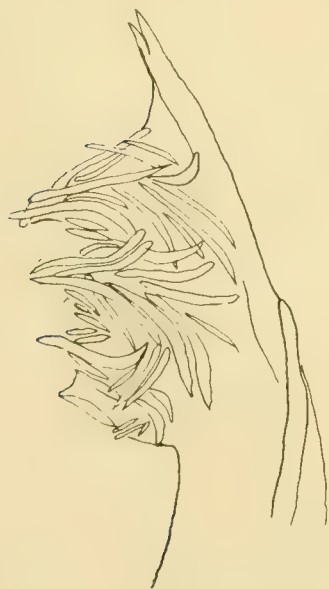


Fig. 37. *D. delicatissima*.

The stalk is of medium length, being 2.5 cm. long, and is rigid. The base is slightly broken, but it is almost certain that it was broad. It is thrown into a number of furrows and ridges, and its upper portion is partly concealed by reflexed lower branches.

The polyparium is compact, bluntly oval in shape, and shows a slightly greater growth in one plane ; it is D-shaped in section in the lower part. It consists of a number of main branches which arise from the stem on all sides, and three portions into which the stem finally divides, and which give the apex a blunt, roughly triangular shape. The majority of the main branches arise from the stem almost at right angles. Two of the lowest branches are flattened, leaf-like structures almost surrounding the stem, leaving two small free spaces, in one of which there is a small branch with cylindrical lower and flattened upper portion. All the branches are flattened out in the upper portion and then break up into lobes on which the polyps are borne.

The polyps are arranged in groups of three to ten, and are placed, at a right angle or little more, on stalks which may reach a length of 1.5 mm. They are low, oval bodies, 0.32 mm. high and 0.64 mm. in maximum width. The

spicules are arranged in eight double rows, each of five pairs of converging spicules, the uppermost pair of each row projecting beyond the polyp. The spicules are flattened spindles, straight or curved, with numerous small spines. The lower spicules measure 0.24 mm. in length and 0.016 mm. in breadth, while the upper projecting spicules have an average length of 0.4 mm. and breadth of 0.032 mm. On the aboral surface of each tentacle there are three rows of small spicules placed transversely.

The Stützbüdel is well developed, consisting of a number of large spicules which may reach a length of 3.7 mm. and a breadth of 0.24 mm.; they may project for a distance of 1.36 mm.

Cortical spicules: (*a*) The stem has spindles, curved or straight, with numerous rough warts all over the surface. Several show a bifurcation at one end and the smaller have spines rather than warts. They are from 0.16 to 3.2 mm. long and from 0.032 to 0.36 mm. broad. They form a complete casing for the stem and branches.

(*b*) The stalk contains thick spindles, straight or curved, three- and four-rayed, and numerous irregular forms. All are thickly covered by rough or branched warts. Spindles are from 0.16 to 1.6 mm. long and from 0.08 to 0.24 mm. broad; they are often slightly club-shaped. The three-rayed forms seem in many cases to be simple spindles with a great development of a spine on one side; they measure up to 0.64 mm. from tip to tip.

Canal-wall spicules: (*a*) In the stem there are thick spindles, straight or curved, from 0.64 to 2.4 mm. long, from 0.16 to 0.45 mm. broad, and thickly covered by rough or branched warts.

(*b*) In the stalk there are spindles from 0.64 to 2.4 mm. long and from 0.16 to 0.48 mm. broad; three-, four- and five-rayed forms varying in length from 0.4 to 1.6 mm., and a few irregular forms. All are covered by numerous rough and branched warts. The spindles have very often a number of small branches which arise in no set order on any part of the surface; several of them have at one end three short branches in tripod arrangement.

Colour—Stalk, deep red in the lower part, gradually becoming lighter towards the top; stem a beautiful golden yellow; branches white; twigs, polyp-stalks and polyp-spicules a bluish-pink.

Locality: Andamans.

DIVISION UMBELLATÆ.

Dendronephthya umbellulifera, Kükenthal.

A magnificent white colony 25 cm. high seems referable to this species. From the base of the stem, which is 19 cm. long and 2 cm. in diameter, there arise root-like processes, 1.5 to 2 cm. long, which are evidently adapted for

securing the colony in mud or a bottom of a similar nature. Surmounting the axis is a cauliflower-shaped head, 6 cm. high and 8 cm. in breadth. The first branch arises about 18 cm. from the base, it is followed by another on the same side, then come three at approximately the same level, one of which again gives off a fairly large branch. These average 2.5 cm. in length and 8 mm. in diameter. Numerous short branches or lobes springing from the main branches bear the polyps in umbrella-like clusters 1.1 cm. in diameter.

The stem and branches are very much wrinkled owing to the shrivelling of the canal walls. There are very few spicules in the partition walls, but examination with a lens shows the outer wall to be covered with minute stellate bodies.

The polyps are non-retractile and are borne on stalks measuring 1.4 to 2 mm. in length. The anthocodæ are 1.25 mm. long and the tentacles when expanded measure 1 mm. On the stalks the spicules are arranged longitudinally, some projecting beyond the base of the polyp like a primitive or pseudo-Stützbündel. Very marked however are the eight double rows of spicules on the anthocodæ disposed "en chevron" and including a very small angle. The same structure though not so definite occurs on the tentacles. Ova of enormous size were present in great numbers in the anthocodæ.

Spicules :—

(a) Those of the cortical wall of the main stem are apparently very diverse in form, but the same general plan may be seen in them all, *viz.*, from a central point rays emanate, varying in number from two to six, and on the ends of these rays there is a knob very irregular and covered with spines which are sometimes simple but often branched. A common measurement is 0.1 mm. \times 0.1 mm. but smaller forms also occur.

(b) In the branches the same types occur but they are slightly smaller in size.

(c) The spicules of the polyps are spindle shaped, covered with simple and branched spines and in some cases warts. The following are common measurements in millimetres :—

Warty spindles, 0.6×0.03 ; 0.5×0.04 .

Spindles with blunt spines, 0.55×0.04 , the spines 0.01 mm. in length.

In the tentacles forms with branching spines occur, *e.g.*, 0.2×0.015 ; 0.15×0.01 , the spines being 0.02 mm. in length. Many of the spines are themselves branched.

Locality : Ganjam Coast, 25 fathoms.

This specimen does not agree in every particular with Kükenthal's description of *D. umbellulifera*, but the differences do not seem to be important. As Kükenthal points out, *Paraspongodes striata* (Thomson and Henderson, "Ceylon Report," 1905, p. 277) may be included in *D. umbellulifera* if a margin be allowed for individual variation.

Dendronephthya pallida, Henderson, nec. *Sp. pallida*, Holm.

The colony is small, measuring 4·5 cm. in height and 4·5 cm. in breadth, with a very short stalk and a large polyparium, much flattened and nearly circular in outline.

The stalk is very short, measuring only 1 cm., *i.e.*, about two-ninths of the total height ; it is granular in appearance and has many longitudinal ridges and furrows, and numerous transverse wrinkles ; it gives off a large number of very thin-walled stolons from the base ; these may arise singly or a number may arise from a blunt process ; they are very various in size.

The polyparium is large, much flattened, regular in outline and compact in appearance owing to the smaller branches being well developed. The stem gives off at each side one main branch, continues for a short distance and then divides into two principal branches ; all the main branches rise at an acute angle to the stem ; they remain relatively short, but through numerous divisions give rise to the enormously developed smaller branches. Many smaller branches also arise from the main stem. The development is well seen on the lower part of the stem where a number of small blunt finger-like processes rise which, when examined, show two polyps or more, smaller heads appearing between larger ones.



Fig. 38. *D. pallida*.

The polyps are arranged in bundles of four to ten polyps, ten being the commonest number, and all are raised more or less to the same level. They are small, somewhat globular bodies, with an average height of 0·6 mm. and an average breadth of 0·54 mm. ; they are placed on their stalks at an angle which varies from right to obtuse. The spicules are arranged in eight double rows ; in each lateral row there are seven to eight pairs of converging spicules, and in the dorsal five pairs. They are small, flattened, curved or nearly straight spindles with numerous prominent spines, their average length being 0·19 mm. ; none of them project beyond the polyp-head.

The Stützbündel shows considerable variation in development within the members of one group of polyps. It is well developed in some and projects beyond the polyp for a considerable distance ; in others it is less marked, while in the smaller it is scarcely noticeable. In the best-developed state it consists of five prominent long spicules, one of which projects beyond the polyp for a distance of 0·6 mm. and is usually about 3 mm. long. Very often a second spicule projects slightly.

Cortical spicules : (a) The stem has spindles, clubbed, pointed or blunt, and usually curved, from 0·3 to 2 mm. long, and from 0·06 to 0·18 mm. broad. They may either be simple or give off long spines at any part, but one of the ends is usually divided into several prong-like portions which may themselves be branched, and just above this there are usually one or two other processes. The arrangement is irregularly transverse on the branches but becomes more irregular on the twigs, giving the surface the appearance of chopped hay.

(b) The stalk spicules are very numerous and various in form. There are clubs, rods, cylindrical forms, rough three-rayed forms, and numerous small very irregular forms varying from short spindles with whorls of huge spines to irregular spinose bodies. All are covered with large spines. Clubs vary from 0·24 to 0·48 mm. in length ; the rods and the three-rayed forms are very scarce, the majority of the spicules being of irregular form.

Canal-wall spicules : (a) The stem spicules are for the most part small flattened spindles often with attempts at branching, and showing peculiar ragged ridges running more or less parallel to the length ; these are 0·06 to 0·36 mm. long, and 0·018 to 0·025 mm. broad. There are also larger spindles, which may have a length of 0·6 mm. and a breadth of 0·09 mm., with the same ragged edges, but also with a few pointed spines on the sides.

(b) Those of the stalk are similar to the preceding, but are more varied in shape and on the whole considerably larger. They are spindles, bent clubs, three-rayed forms and flattened forms which vary from spindles to branched forms. With the exception of the last-mentioned, all have a few prominent simple spines. All show ragged ridges, and many of the curved clubs have well-developed pointed spines on the convex surface. The spindles may reach a length of 0·78 mm. and a breadth of 0·09 mm.

Colour—White generally, but here and there the Stützbündel spicules and a few of the spicules of polyps and stalks are pale pink, or have a short pale pink axis.

Locality : Yé, Burma.

Dendronephthya obtusa, Henderson.

The colony is rounded in form, oval in shape, and measures about 4·5 cm. in height and 2·5 cm. in breadth.

The stalk is about 2·5 cm. long, flattened, and by no means rigid. It is granular in appearance, and incomplete owing to the absence of the basal portion.

The polyparium is roundish, oval in outline, the long axis standing at an angle to the axis of the stalk. From the lower portion of the stem small branches are given off in two regular whorls. In the upper portion the

branches have developed more strongly. Above this the stem ends in two blunt conical processes, from the side of one of which a large branch is given off, the largest in the colony, which almost immediately divides into two. On the tip of this conical process there is a faint indication of polyps, while on the tip of the other there is the beginning of a small branch consisting of a cluster of polyps. All the branches are cylindrical in shape, and give rise directly or by repeated division to the polyp-bearing twigs. The stem itself is slightly flattened in the same plane in which a slight flattening of the polyparium is found.

The polyps are arranged in groups of two to ten, and are placed at an obtuse angle on stalks (about 1 mm. long) which diverge considerably. They are oval in shape and average about 0.54 mm. in height and 0.66 mm. in width. The polyp-spicules are arranged in eight double rows; in the dorsal rows there are four to six pairs of converging spicules, in the others five to seven pairs. In every row one of the uppermost pair is slightly longer than its neighbour and projects a very little beyond the polyp. The lower polyp-spicules average about 0.2 mm. in length, the upper often measure 0.36 mm. and project for a distance of 0.12 mm. They are all covered with numerous small spines. On the aboral surface of each tentacle there are two compact rows of small flattened, toothed spicules.

The Stütz Bündel is well developed, containing a few large spindles of which one may reach a length of 3.6 mm. and project 1.5 mm. beyond the polyp. The tip of a second spicule may also project a little beyond the polyp.

Cortical spicules: (a) In the stem there are long slender spindles either straight or curved and bearing numerous regularly arranged blunt spines or roughish warts, and in addition a number of smaller spicules slightly flattened and bearing few simple spines, or with toothed edges. The larger vary from 0.42 to 3.0 mm. in length and from 0.06 to 0.17 mm. in breadth. The smaller average about 0.12 mm. in length. They are arranged irregularly on the main stem and branches, but more longitudinally on the smaller branches and twigs.

(b) In the stalk there are spindles, three- and four-rayed forms, clubs, incipient three- and four-rayed forms, and numerous irregular branched forms. These are all covered more or less thickly with large prominent rough or branched warts, and the spindles often show a very deep bifurcation at one end. In addition there are a few irregular spindles, bluntly dumb-bell-shaped, or tapering forms with a few whorls of warts.

The spindles measure up to 1.56 mm. in length and 0.12 mm. in breadth, while a few of the largest three-rayed forms average about 1.2 mm. in greatest length.

Canal-wall spicules: (a) In the stem there are small pointed spindles with fairly numerous blunt spines, and a few four-rayed forms, but the majority

are smooth, flattened, spindle- to star-shaped forms. The pointed spindles measure up to 0.9 mm. in length and 0.15 mm. in breadth.

(b) In the stalk there are spindles, three- and four-rayed forms, thickly covered with more or less regularly arranged rough warts, some of which may reach a height of about 0.08 mm. The spindles vary from 0.48 to 1.8 mm. in length and from 0.09 to 0.18 mm. in breadth, and the three-rayed measure up to 0.9 mm. in length.

Colour—The stalk is whitish; the main stem yellowish-white; the main branches more deeply tinged with yellow than the stem; the smaller branches and twigs are salmon-pink; the polyps white, spicules and bodies alike.

Locality : Andamans (J. Wood-Mason).

Dendronephthya grandiflora, Henderson.

The colony is large, very compact, much flattened in one plane, and has a regular oval outline, with the long axis of the oval nearly perpendicular to the stem. It measures 8.5 cm. in height and 8 cm. in maximum breadth.

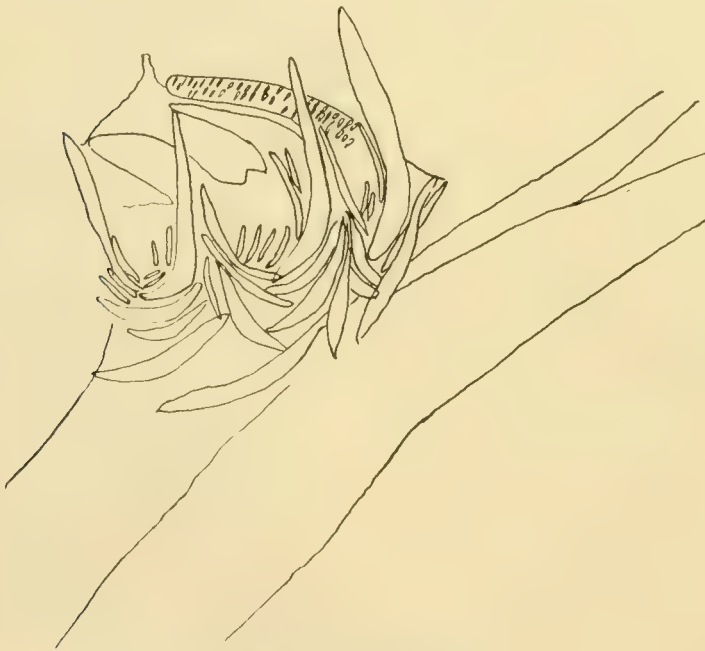


Fig. 39. *D. grandiflora*.

The stalk is short, thick and fairly rigid, wrinkled and ridged, granular in appearance, and gives off a few stolons. It measures about 2 cm. in height, about one-fourth of the total height of the colony.

The polyparium is large, compact, regular in outline, oval in shape, the long axis being almost at right angles to the stem. From the lower part of the stem a number of branches are given off, and almost directly above this the

main stem gives off in one plane, opposite one another, two large branches which rise obliquely at an angle to the stem. The stem rises for a short distance and then divides into two main mutually divergent portions or branches in the same plane as the lower. These four main branches give off in close proximity on all sides numerous branches which by repeated divisions give rise to the flattened twigs on which the polyp-stalks arise. The lower branches are flattened,

leaf-like or fold-like structures, two of which with very broad bases are reflexed and almost surround the stem, the collar portion hiding the upper part of the stalk, leaving only two small spaces which are occupied by the upper flattened leaf-shaped portion of two small branches which arise at a slightly lower level and have ordinary cylindrical stems. Above the lower flattened branches several of the branches near the base of each principal branch show a slight tendency to flattening either in the stalk or in the upper portion or in both.

The polyps are arranged in small groups of four to seven individuals on stalks of medium length. The members of a group stand fairly close together on the upper part of the polyparium but are slightly more divergent on the lower part. On the flattened lower branches they occur singly or in small groups of three to four polyps. The polyps are roundish bodies measuring on an average 0.84 mm. in height and 0.9 mm. in breadth. They are placed at an obtuse angle on stalks which average a little over 1 mm. in length. The polyp-spicules are arranged in eight double rows of five pairs; the second pair from the top are usually slightly longest and one of them projects beyond the polyp; that of the dorsal row, however, is not so well developed. The lower spicules have an average length of 0.24 mm. while the longer upper spicules may reach 0.48 mm. and project for a distance of 0.21 mm. Between the upper rows at the apex of the polyp several small spicules may be seen lying irregularly. On the aboral surface of the tentacles there are two rows of horizontally placed spicules, closely packed together; these are flattened toothed spindles.

The Stützbündel is well developed, one or two of the spicules being very large. One of these may reach a length of 4.0 mm. and project for a distance of 1.2 mm. beyond the polyp; the tip of a second is usually seen projecting for a short distance. Polyps are found in which the Stützbündel spicules are much shorter and scarcely project at all, while there are still smaller polyps in which the Stützbündel is represented by several spicules which do not project.

Cortical spicules: (a) The spicules of the stem are very large spindles, either straight or curved, and covered with numerous regularly arranged very rough warts. Some of the larger spindles show bifurcation at the end. Many of the smaller spindles have fewer, smoother warts which approach blunt spines in shape. The smaller spindles vary from 0.12 to 0.36 mm. in length and from 0.042 to 0.06 mm. in breadth. The rough, and on the whole, larger spicules vary from 0.33 to 4.8 mm. in length and from 0.12 to 0.36 mm. in breadth. In the stem and main branches they are arranged for the most part transversely, while in the smaller branches and twigs the arrangement is more nearly longitudinal.

(b) The spicules of the stalk include short spindles, usually curved and often with an expansion on the convex side, three-sided, flattened, oval or four-

sided, three-rayed, four-rayed forms, irregular stars, and small forms which look like two whorls of prominent rough warts joined together. All these diverse forms are covered by numerous prominent very rough or branched warts, more or less regularly arranged. There are also flat, smooth, spindle-to star-shaped forms. A few measurements are given but the variability is more marked both in form and in size than is suggested by the description. Spindles measure up to 1.5×0.21 mm., but when expansions are present a breadth of 0.3 mm. is reached; three-rayed forms, 0.42 to 0.30 mm.; four-rayed, 0.36×0.30 mm., three-sided, 0.36×0.30 mm.; clubs up to 0.42×0.13 mm.; oval or four-sided forms, 0.42×0.18 mm. There are also numerous rayed forms in which the rays are not all in one plane.

Canal-wall spicules: (a) Those of the stem are thick spindles, measuring up to 1.8×0.30 mm., either straight or curved, and thickly covered with large blunt, rough spines. There is also a series of spindles which have fewer, smoother, blunt spines. It is possible that three-rayed forms are present, as several of the spicules approach that type.

(b) The spicules of the stalk are thick spindles, either straight or curved, often showing bifurcations at the end, three- and four-rayed forms, irregular three-rayed forms with a flattened ray, flat, smooth, spindle-shaped to star-shaped forms, small, flattened, smooth, irregular spindles which may be branched, and other irregular flat forms. The spindles, three-rayed and irregular three-rayed forms are thickly covered by rough warts which may be branched; the four-rayed forms usually have fewer and simpler warts, but almost every possible grade between the two varieties of tubercles is found. Spindles measure up to 1.8×0.30 mm.; three-rayed forms, 1.5×0.9 mm.; four-rayed, 1×0.9 mm.; irregular three-rayed, 1×0.9 mm., the broad ray, 0.42 mm., often showing bifurcation.

Colour—The stalk is pinkish-white for a small space at the base, the remaining part is white; the stem and main branches are white; the smaller branches are yellowish; the twigs and polyps are chocolate-brown, and the polyp-tentacles white with a red band of spicules on the aboral surface.

Locality: Off Colombo, $26\frac{1}{2}$ fathoms.

Dendronephthya conica, Henderson.

The species is represented by a complete colony which measures 8 cm. in height and has a maximum diameter of 4.2 cm.

The stalk is long, measuring 4.6 cm., slender, flabby, and marked by numerous longitudinal ridges and furrows which are due to the collapse of the walls. It gives off a few short, blunt, thin-walled stolons at the base, is granular in appearance and leathery in texture though apparently flabby.

The polyparium is compact, regular in outline, inverted cone-shaped with a slight flattening on one side, and reaches its largest diameter just a little below the tip. It consists of numerous branches which arise on all sides of the stem and which gradually increase in size towards the tip of the stem. Near the tip three large branches are given off among which the stem ends in a small branch.

The polyps are arranged in groups of six to twenty, and these again into larger groups. The polyps of a group all reach practically the same level and in the larger groups the surface is generally flat, but here and there a marked tendency to concavity is to be observed. The polyps sit at an obtuse angle on short stalks; they are low, oval bodies, measuring up to 0.40 mm. in height and 0.48 mm. in breadth. The spicules are arranged in eight double rows in each of which there are four to five pairs of converging spicules. The uppermost pair is slightly larger and may project a little. There are in addition a few spicules arranged horizontally. The spicules are flattened spindles, either straight or curved, with small spines on their surface, and in a few cases bifid at one end. They measure on an average 0.24 mm. in length and 0.025 mm. in breadth, while the uppermost pair may reach a length of 0.32 mm. and a breadth of 0.026 mm. On the aboral surface of each tentacle two rows of small rod-like spicules are present.

The Stützbündel is not strongly developed. It consists of a few spicules, one or two of which may reach a length of 1.36 mm., and a breadth of 0.048 mm., and may project for a distance of 0.24 mm.

Cortical spicules: (a) The stem contains spindles, either straight, curved or sharply bent, from 0.32 to 3.1 mm. long, from 0.064 to 0.24 mm. broad, and covered with prominent smooth to rough spines. In addition there are a few of each of the following—clubs, irregular stars and irregular three-rayed forms. Nearly all are either faint pink or brownish-pink in colour, only a few being colourless, and in several there is a division at one end into prongs which run parallel to one another.

(b) In the stalk there are irregular spindles, clubs, stars, rods, and a number of large three- and four-rayed forms; also a few large spindles, either straight or curved, covered on all sides with large spines or having them markedly developed along one side. The large spindles may reach a length of 0.64 mm. and a breadth of 0.08 mm. The rayed forms have a maximum length of 0.75 mm. The irregular forms vary in length from 0.08 to 0.32 mm. The larger three-rayed forms are pink and lie on the surface of the stalk visible to the eye.

Canal-wall spicules: (a) In the stem there are straight or curved spindles, clubs, a few three-rayed forms, and a number of small irregular spindles. All of these are thickly covered by rough warts. In addition there are various

smooth, flat rods, bars and spindles, with projections on the two lateral surfaces only. Spindles are from 0.12 to 1.6 mm. long and from 0.048 to 0.19 mm. broad. Clubs reach a length of 0.64 mm. Smooth rods, bars or spindles are from 0.06 to 0.12 mm. long and average 0.012 mm. in breadth.

(b) The stalk spicules are straight or curved spindles and three-rayed forms thickly covered by very prominent rough warts. There are also irregular stars and globular forms, and smooth, flat forms similar to those of the stem except that they have longer lateral projections. Spindles vary from 0.24 to 0.88 mm. in length and from 0.06 to 0.16 mm. in breadth. The three-rayed forms have a maximum length of 0.88 mm. while a ray often measures 0.12 mm. in breadth. Smooth, flat forms vary from 0.06 to 0.24 mm. in length and have an average breadth of 0.02 mm.

Colour—Stalk brownish in lower part, becoming gradually lighter till it is greyish in upper part; the stem gradually becomes pinkish-grey; principal branches almost a salmon-pink; polyps pink or grey, according to the spicules; tentacles a translucent grey.

Locality: Andamans (J. Wood-Mason).

Dendronephthya multispinosa, Henderson.

The colony is characterised by its roundish polyparium, its regular outline, its distinctly flattened lower branches, and the fact that the polyps are all or nearly all on the surface. It presents a fairly compact appearance owing to the method of branching. The colony is about 4 cm. high and about 3.5 cm. broad.

The stalk is short, but its actual length cannot be given, as the lower part is evidently torn away; its upper part is covered by a collar formed by the reflexed flattened branches. It is granular in appearance and speckled red.

The polyparium is compact and rounded, showing a slight flattening and tending to develop into two main knob-like portions. At the upper end of the stalk three flattened branches are given off, two of which have very wide bases and may be called leaf-like, while the third has a cylindrical stalk and a flattened upper portion resembling an umbrella turned inside-out. Above this the stem divides into two main portions which form the bases of the knob-like processes above-mentioned. From these branches are given off, which divide into smaller branches, which in turn give rise to the small flattened twigs from which the polyp-stalks arise, thus bringing all the polyps to the surface and giving the colony a spiny appearance, due to the projecting Stützbündel spicules.

The polyps are placed on short stalks at an obtuse angle, and are arranged in small groups of four to seven individuals; several groups may be closely pressed together, giving the appearance of a large group with many more in-

dividuals. The heads are small and somewhat flattened laterally. They measure on an average 0.45 mm. in length and 0.6 mm. in breadth. The spicules are arranged in eight double rows, each containing five to seven pairs of converging spicules, one of the lowest of which may be a little longer than the others. In addition to these a few spicules seem to form a sort of lateral accessory Stützbündel. Along the aboral surface of each tentacle there are two rows of small, flattened spicules, regularly arranged.

The Stützbündel shows considerable variation, depending on whether the polyp-stalk is a direct continuation of the twig or arises from the lateral surface. In the former case the Stützbündel is very well developed, consisting of three to four large spicules, of which one may reach a length of 3.2 mm. and project 0.9 to 1.0 mm. At times a second spicule projects a little. In the latter case it may consist of a number of spicules forming a sheath, three to four of them being slightly larger than the others, and two always projecting. In the youngest polyps a similar sheath is formed, but while two or three spicules are slightly larger than the others, none of them project.

Cortical spicules : (a) The stem contains large spindles, either straight or curved ; short, thick spindles ; small forms approaching clubs in shape, and small spherical and flattened bodies. They are arranged irregularly transversely on the main stem and branches, but on the smaller branches and twigs take up a longitudinal position. The large spindles may be 4.8 mm. long and 0.45 mm. broad ; they show several interesting features—they are often divided into a number of prongs at one end, which, if two in number, stand at an angle to one another, but if more than two, lie invariably parallel to one another and in contact ; at the other end they are abruptly contracted and then produced into a slightly curved, tapering, finger-like process. At other times they send off a process near one end which curves round and lies practically parallel to the main portion of the spicule. All the spicules are thickly covered with prominent blunt, multituberculate spines regularly arranged, which in the globular and flattened forms may be produced to a point.

(b) The stalk spicules are very various, and include short, thick, blunt spindles ; cylindrical, globular, three- and four-rayed forms ; irregular flattened forms ; and spindles with one end forked. All are covered by low, blunt, toothed warts.



Fig. 40. *D. multispinosa*.

Canal-wall spicules: (a) The stem has short, thick spindles; cylindrical, globular, three- and four-rayed forms. In the last-mentioned, three of the rays form a tripod from which the fourth rises at right angles. All are thickly covered with prominent projections which vary in shape from simple or branched thorns to slightly toothed warts. In addition there are small, flat, smooth spindle-shaped to star-shaped forms. A considerable resemblance is shown to several of the forms occurring in the stalk cortex.

(b) The stalk canal walls show a great variety of spicules, including spindles, cylindrical rods, three-, four- and five-rayed forms, cylindrical forms giving off a number of branches which may again branch, and flat, smooth, spindle- to star-shaped forms. Many of the four-rayed forms are in the shape of tripods, as in the stem canal walls. Others are twins or forms of which one half is the exact mirrored counterpart of the other. They are covered with prominent toothed warts somewhat regularly arranged, though in some the projections are thorn-like and may reach a length of 0.078 mm., in which case they show branching. The measurements of spicules in the case of stalk cortex, and stem and stalk canal walls are too variable to be of use for specific determination.

Colour—Stalk white to yellowish-white with spots of red; stem and principal branches pale orange-yellow; twigs pale to deep coral-red; polyps white.

Locality: Andamans.

Dendronephthya gilva, Henderson.

The colony is irregularly ball-shaped, showing a tendency to divide into two spheres of equal size. It is slightly flattened, and has a very short stalk. The colony is about 3 cm. high, and about 4 cm. broad.

The stalk measures 10 mm. in length, is fairly thick, granular in appearance, and gives off at the basal end a number of short, slender stolons. Its upper part is hidden, collar-wise, by the reflexed lower flattened branches.

The polyparium is roundish, showing at its apex a tendency to divide into two equal lobes. It has a very regular outline and the surface is more or less flat. It is formed of a number of principal branches which have their base of attachment immediately above the flattened, lower, leaf-like branches—in fact, with the exception of one branch, they may be said to have their origin on the upper surface of these flattened branches. These principal branches divide a number of times and finally give rise to short, thick twigs on which the polyp-stalks arise.

The polyps are arranged in bundles of four to eight individuals somewhat closely placed together; four or five of these bundles often form a kind of

cluster, and as all the polyps reach almost the same level, the surface is nearly even. The heads, which present a beautiful contrast in colour to the rest of the colony, are small, varying from 0.48 to 0.6 mm. in length, and from 0.36 to 0.48 mm. in breadth, and are placed on the stalk at an angle which varies from right to obtuse. The spicules are numerous and are arranged in eight double rows in each of which there are seven to eight pairs of small spicules, none of which project. They are small, flattened spindles with toothed edges, averaging 0.12 mm. in length.

The Stützbündel shows considerable variation; in certain polyps it is well developed, and is formed usually of two to three spicules which may reach a length of 5.6 mm. and of which one, or two, may project 0.36 to 0.6 mm. beyond the polyp-head; in others it is not so well developed, and its projecting part may be almost concealed by the polyp's lying parallel to it; while in yet other cases it is so small that it can scarcely be said to be present. In the majority of cases the spicules are slightly shorter than the above measurements indicate.

Cortical spicules: (a) Those of the stem are long spindles which form an irregular network in the meshes of which smaller spindles and three-rayed forms occur. This arrangement has a striking effect owing to the contrasting colours of the spicules, the larger being pale orange-yellow, and the smaller white; the contrast is accentuated by the sporadic occurrence of single pink spicules among the large orange forms. The arrangement is continued into the twigs, but here the red colour predominates in the large spicules, the yellow being absent or masked by the red. The large spicules are spindles, straight or curved, with numerous blunt, spine-like processes regularly arranged; these spindles often divide at one end into a number of prongs which may be wide spread, or crossed over and twined with one another. They vary from 0.7 to 5.0 mm. in length, and from 0.048 to 0.3 mm. in breadth. The three-rayed forms are much smaller, having a maximum length of 0.48 mm., and breadth of 0.36 mm., while the smaller spindles vary from 0.25 to 0.6 mm. in length.

(b) The stalk contains spicules similar to those of the stem, but in addition there are clubs, four- and five-rayed forms, tripod shapes with a thick piece at



Fig. 41. *D. gilva*.

the junction of the three legs, a type of spindle which may be called golf-club-shaped, and a form which may be called a spine with spinules—the latter measuring on an average 0.09 mm. in length. The spindles are shorter and thicker than those of the stem, varying from 0.54 to 1.8 mm. in length, and from 0.04 to 0.18 mm. in breadth. Clubs are 0.48 mm. long by 0.15 mm. broad. The spindles have prominent simple spines regularly arranged, but on the others the spines are large, very pointed and usually branched, especially on the clubs, tripods and curved spindles, the prominent spines being on the convex surface of the latter.

Canal-wall spicules : (a) In the stem there are long, thick spindles, in many cases showing bifurcation at one end, large three-rayed forms, and a number of smaller spindles either straight or curved. All these have simple spines distributed fairly regularly over the surface.

(b) The stalk has spindles, clubs, three- and four-rayed forms, and these resemble the spicules of the stalk cortex except that they are smaller and have simpler spines.

Colour—Stalk yellowish-white ; stem, principal branches and twigs pale orange-yellow ; polyp-stalks pink ; polyps white.

Locality : Andamans.

Dendronephthya brevirama, Burchardt, var. *andamanensis*, Henderson.

This species is represented by a single specimen which measures 3.7 cm. in height and 4.4 cm. in greatest width.

The stalk is very short, about 1 cm. in length, slender and rigid. Its outer surface is granular, and from the base a number of stolons are given off.

The polyparium is oval in shape with the long axis at right angles to the axis of the stalk, very compact, with an even, unbroken surface. It is greatly flattened in one plane, the two main branches arising in this plane on opposite sides of the stem. The two large lateral branches and the upper portion of the stem are identical in structure, short, thick and cylindrical, and give off numerous short, cylindrical branches on all sides. These branches give rise by repeated division to the polyp-bearing twigs. The two lowest branches are flattened in the lower part, and from the upper surface of the flattened portion small secondary rounded branches are given off.

The polyps are arranged in groups of four to fifteen and stand in close contact ; they may occur singly on the edge of the flattened branches. All are so arranged that they reach the surface of the polyparium. They are low and round in shape, measuring 0.48 mm. in height and 0.50 mm. in breadth, and are placed at an obtuse angle on the short stalks which may reach a length of about 1 mm. The spicules are arranged in eight double rows, in each of which there

are six to seven pairs of converging spicules, one of the uppermost pair of each double row projecting a little beyond the polyp. The spicules are spindles either straight or slightly bent, with few regularly arranged spines, and vary from 0.11 to 0.27 mm. in length, while the projecting spicule is usually about 0.4 mm. On the aboral surface of each tentacle there are two rows of small flat, toothed rods which average about 0.04 mm. in length.

The Stützbündel is well developed, one of the spicules measuring on an average about 2.7 mm. in length and projecting for a distance of 0.46 to 0.8 mm. beyond the polyp; it has on its almost smooth projecting part a small number of regularly arranged spines.

Cortical spicules: (a) In the stem there are straight or curved spindles which vary greatly both in size and in the number and size of the projecting spines; in the smaller spindles there are fewer and simpler spines, on the larger more numerous simple or blunt branched spines; in both alike the spines are regularly arranged. The spindles vary in length from 0.24 to 3.0 mm. and in breadth from 0.048 to 0.37 mm. In addition there are a few flat, smooth, striated, blunt rods.

(b) In the stalk there are spindles, three-rayed, four-rayed, and a few irregular, star-shaped and slightly elongated forms. All are closely covered by rough branched warts. The spindles vary in length from 0.24 to 1.9 mm. and in breadth from 0.08 to 0.19 mm. There are also a few smooth, flat, striated rods.

Canal-wall spicules: (a) In the stem there are large spindles closely covered by rough, branched warts. They vary in length from 0.4 to 2.4 mm. and in breadth from 0.09 to 0.29 mm. In addition there are a few with fewer and simpler warts, which average about 0.4 mm. in length.

(b) In the stalk the spindles are similar to those of the stem but slightly shorter and thicker. There are in addition three- and four-rayed forms, and forms with three to four rays arranged tripod-fashion with the principal ray standing at right angles to the point of junction.

Colour—The stalk, stem and principal branches are light orange-yellow; the twigs yellowish-white; the polyp-stalks white, and often streaked with red; and the polyp-spicules a faint bluish-purple.

Locality: Andamans.

Dendronephthya elegans, Henderson.

This species is represented by one complete specimen which measures 5.1 cm. in height and 2.9 cm. in greatest breadth.

The stalk is 2 cm. long, thick, fairly rigid, granular in appearance with its upper part hidden by the reflexed lower branches.

The polyparium is more or less regular in outline, and has a nearly con-

tinuous surface. It consists of a large number of small branches of almost equal length. The branches on one side show a slightly larger growth and there is thus a hint of development in one plane. The branches are rounded and give rise by repeated divisions to the polyp-bearing twigs.

The polyps are arranged in groups of five to nine, but seven is the commonest number. They also occur on the lower branches in smaller groups and even singly. They are low and round, measuring 0.48 mm. in height and 0.72



Fig. 42. *D. elegans*.

mm. in breadth, and are placed almost at right angles on the stalk, which may reach a length of 1.5 mm. The spicules are arranged in eight double rows in each of which there are seven pairs of converging spicules; the uppermost pairs may be slightly larger and project beyond the polyp. The spicules are spindles, straight or curved, with few protuberances on the surface; they average 0.24 mm. in length, while the upper projecting spicules may reach a length of 0.32 mm. On the aboral surface of the tentacles there are two rows of bluntly converging spicules, the ends of which are roughly alternate.

The Stützbündel is well developed; one of the spicules is usually much larger than the rest and projects for a considerable distance beyond the polyp-head. It may be 3.3 mm. long and project 1.04 mm.

Cortical spicules : (a) Those of the stem are straight or curved spindles, covered with numerous blunt warts; they vary in length from 0.48 to 3.3 mm. and in breadth from 0.048 to 0.48 mm.

(b) In the stalk there are spindles, clubs, rods or bars, rayed forms, and numerous irregular forms. They are all covered by very prominent rough warts, and on the spindles blunt spines also are usually found. The spindles vary from 0.24 to 0.8 mm. in length, and from 0.11 to 0.17 mm. in breadth.

Canal-wall spicules : (a) In the stem there are spindles, either straight or sharply curved, covered with rough warts. They vary in length from 0.43 to 1.7 mm. and in breadth from 0.11 to 0.24 mm.

(b) In the stalk there are spindles, either straight or curved, three- and four-rayed forms, and a number of irregular, slightly globular forms. They are all thickly covered by very rough warts. The spindles measure from 0.4 to 1.6 mm. in length, and from 0.16 to 0.24 mm. in breadth. The three- and four-rayed forms are almost of the same length as the spindles. Of the rayed forms two or three of the rays are in several cases short and thick while the remaining ray is long; in others, one of the rays may be short and the others of equal length.

Colour—Stalk light coral-red; stem, branches and twigs light mauve; polyps white.

Locality: Andamans, 20 fathoms.

Dendronephthya gregoriensis, Henderson.

The colony is bush-shaped and measures 7 cm. in length and 4·5 cm. in greatest width.

The stalk is 3·3 cm. in length and of moderate thickness. It is somewhat flabby, and gives off a large number of long slender stolons at its base.

The polyparium forms almost a perfect cylinder, rounded off at its apex and slightly irregular owing to the feebler development of the branches on one side. It shows no trace of flattening, is compact in appearance and has an approximately even surface, almost all the polyps reaching to the same level. The main stem continues almost its whole length entire, only dividing into two small branches at the tip. From the whole surface of the stem at right, or almost right angles, short rounded branches are given off in every direction. These divide into a number of smaller branches from which the polyp-bearing twigs arise. Only one of the lower branches shows a slight flattening in the stalk.



Fig. 43. *D. gregoriensis*.

The polyps are arranged in small bundles of four to seven, and usually stand closely together. They are oval in shape and placed at an obtuse angle on short stalks of about 1 mm. in length. They have an average height of 0·6 mm. and breadth of 0·7 mm. On the polyp the spicules are arranged in eight double rows; in each lateral row there are five to six pairs and in each dorsal about three pairs. The uppermost or second uppermost pair of the lateral rows are slightly longer than the others and project a little beyond the polyp. They are straight or slightly curved spindles on an average 0·42 mm. in length, while the lower polyp-spicules measure about 0·18 mm. in length. They are covered by prominent spines which stand at right angles to the surface, except on the projecting portion where they are directed obliquely towards the tip.

The Stützbündel is well developed in certain polyps, where one of the spindles may reach a length of 2.4 mm. and may project 0.4 mm. beyond the polyp, in the others they average about 1 mm. In both types the tips of two or three more project slightly.

Cortical spicules: (a) In the stem there are long spindles, either straight or curved, and covered with regularly arranged rough blunt spines or thorns. They vary in length from 0.45 to 2.5 mm., and from 0.07 to 0.24 mm. in thickness.

(b) In the stalk the spicules are very varied in form, short, thick spindles which often show bifurcation at one end, short clubs, thick, cylindrical forms with three or more rays at one end, three-rayed forms, small incipient four-rayed forms, simple thick and broad flat rods, and numerous irregular to star-shaped forms. All are covered with rough warts, many of which are much branched.

The spindles average about 1.1 mm. in length and 0.15 mm. in breadth, but spicules of over 1.6 mm. are also present. The cylindrical forms average about 0.7 mm. and the clubs 0.48 mm. in length.

Canal-wall spicules: (a) In the stem there are long spindles with a few prominent spines, measuring up to 1.2 mm. in length by 0.18 mm. in breadth.

(b) In the stalk there is the same diversity of shape as in the cortex; short thick spindles, three-rayed forms, a few clubs and a type of spindle which has two large flat expansions in close proximity to one another, on one surface. The spindles may be straight or curved, or even S-shaped, and vary in length from 0.24 to 1.8 mm. in length, and in breadth from 0.12 to 0.36 mm. The spindles with the foliar expansions may reach a length of 0.9 mm., while the clubs average about 0.36 mm. in length and 0.18 mm. in breadth. In addition to the above there are smooth, flat spindles and star-shaped forms.

Colour—The colour of the stalk is pinkish-white with the lower part yellowish-white; the main stem white, with here and there short streaks of red; the lower parts of the branches pinkish-white, the upper parts red; the polyp-stalks and polyps white; the Stützbündel white with a faint pink tinge in parts.

Locality: Gregory Islands, Mergui Archipelago.

To this species is referred another colony which measures 7 cm. in height and 4.5 cm. in greatest breadth.

Locality: Yé, Burma.

Dendronephthya tripartita, Henderson.

This species is represented by a small colony which measures 4 cm. in height and 3 cm. in maximum width.

The stalk is short, about 2 cm. in length, thick and fairly rigid. It is granular in appearance and gives off a large number of stolons which are often branched.

The polyparium is rounded in form, compact in appearance and regular in outline. From the lower portion of the stem a large number of small branches are given off, then the stem divides into three main portions which stand out almost at right angles to the stem. Each of these divides into smaller branches which by division give rise to the polyp-bearing twigs, and also gives off small branches similar to those on the lower part of the stem. These branches also give rise to knob-like projections at the top of the colony, which is somewhat flattened on its summit and on one side. Some of the lower branches show a slight flattening in the stalk and a more marked flattening in the upper portion, or the upper portion is slightly flattened while the lower portion is not.

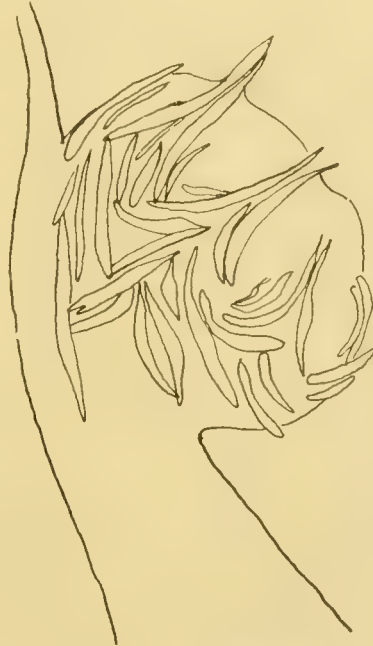


Fig. 44. *D. tripartita*.

The polyps are arranged on short stalks in small groups of six to fourteen on the upper part, but in the lower part they may occur singly or in small groups of two to five each. In the upper portions several of the small groups may be in close contact, thus forming a large group. The polyps are small, averaging 0.55 mm. in height and 0.5 mm. in breadth, and are placed on the stalk, 1 mm. in length, at an obtuse angle. The spicules are arranged in eight double rows; in the lateral rows there are six pairs of spicules, and in the dorsal rows there are four to five pairs. The uppermost spicules may be longer than the others and project beyond the polyp. The lower polyp-spicules are about 0.30 mm. in length, the upper about 0.42 mm., projecting about 0.24 mm. beyond the polyp. They are flattened spindles either curved or straight, or, in the case of the upper, sharply bent near one end, and covered with spines which are directed obliquely towards the tip on the projecting part.

The Stützbündel is well developed, one of the spicules usually projecting for a considerable distance, 0.8 mm., beyond the polyp and reaching a length of 3.0 mm. The tips of two more may be seen projecting slightly beyond the polyp. In other cases the spicules are smaller and more numerous, their tips meeting at an angle and projecting slightly beyond the polyp.

Cortical spicules: (a) In the stem there are slender spindles either curved or straight, with numerous regularly arranged blunt spines which may be

smooth or may bear many rough tubercles. They vary from 0.39 to 3.5 mm. in length. They are arranged irregularly on the stem and principal branches, they assume a more regularly transverse arrangement in the smaller branches and are nearly longitudinal in the twigs and polyp-stalks.

(b) In the stalk there are spindles, clubs, three-rayed and forked forms with one long ray, short rods with one whorl at one end, irregular globular and star-shaped forms, and spindles with an apparent foliar expansion. They are all covered with numerous prominent rough warts which are more or less regularly arranged and may be much branched. In some of the smaller the spines are simpler and less numerous. The spindles measure up to 1.1 mm. in length and 0.18 mm. in width. The clubs average 0.55 mm. in length, the three-rayed forms about 0.9 mm. and the rods with one whorl at an end about 0.15 mm.

Canal-wall spicules: (a) In the stem there are short, thick spindles of about 0.48 mm. in length and 0.09 mm. in breadth, with a few simple spines on the surface. In addition there are small, flat, smooth spindle-shaped to star-shaped forms.

(b) In the stalk there are spindles similar to those of the stem canal walls, but larger and thicker, and in addition, clubs, spindles with large projections on the convex side, a few three- and four-rayed forms, and also a few of comet shape. They are covered by numerous protuberances, which vary in shape from blunt spines to rough warts, and are somewhat regularly arranged. The spindles have an average length of 1.08 mm. and may reach a breadth of 0.21 mm. The clubs average 0.6 mm. in length and 0.18 mm. in breadth, the three-rayed forms about 0.66 mm. in length, the spindles with projections about 0.55 mm. in length and 0.12 mm. in breadth. There are also numerous small, flattened, globular forms with one large spine.

Colour—The lower part of the stalk is pinkish-white, the upper part of the stalk and the lower part of the stem white; the upper part of the stem pinkish-white; the branches and twigs red; the polyps yellowish-white, and on the lower branches they may be white to pinkish-white.

Locality: Forrest Strait, Mergui Archipelago.

This species and the preceding one approximate very closely to one another, and also to the *rigida* group of the *Diraricatae*.

***Dendronephthya brachycaulos*, Henderson.**

This species is based on a specimen which measures 5.2 cm. in height and 3.3 cm. in greatest breadth.

The stalk is long, measuring 3.5 cm., it is flabby and greatly collapsed at its lower end, but spreads out into a thick, fairly rigid portion at its upper

end. It gives off a few stolons at its base, is granular in appearance and somewhat leathery in texture.

The polyparium is imperfectly oval in shape, with the long axis at an angle to the stem, and is slightly flattened in one plane. The surface is well developed and almost continuous on one side, but on the other it is irregular. The branches are almost uniform in length, rounded and thick, and give rise to the polyp-bearing twigs by repeated divisions. The stem rises to the tip without any division.

The polyps are arranged in groups of four to eleven, and these again are arranged into larger groups, which have a flat surface due to the polyps in a group all reaching the same level, and thus all reaching the surface of the polyparium. They are low and round, being 0.56 mm. high and from 0.48 to 0.56 mm. broad. They are placed at an obtuse angle on stalks which vary greatly in length—from 0.16 to 0.5 mm. The spicules are arranged as follows: There are a few horizontal rows of spicules and above these there are eight double rows of three pairs of converging spicules, the uppermost pair of each row slightly larger than the others, and projecting slightly beyond the polyp. They are flat spindles with few projections and measure on an average 0.4 mm. in length and 0.048 mm. in breadth.



Fig. 45. *D. brachycaulos*.

The Stützbündel consists of a number of spindles which measure from 0.64 to 1.4 mm. in length, but scarcely project beyond the polyp-head.

Cortical spicules: (a) The stem shows straight or curved spindles and roughly spindle-shaped forms thickly covered by numerous smooth to rough spines; these forms are blunt at the ends or show division into two or three prongs, which either spread out or lie in close contact with one another throughout their length. The spicules vary from 0.24 to 1.12 mm. in length, and from 0.064 to 0.24 mm. in breadth. They are arranged in a very irregular manner on the stem and principal branches, these parts acquiring an appearance suggestive of a heap of pins, but they tend to run more parallel to the length of the secondary branches and twigs.

(b) In the stalk the spicules are spindles, imperfect clubs, three-, four- and five-rayed forms, all of which are thickly covered with prominent simple to branched spines. In addition there are a few less complex irregular spindles, rods and stars. Spindles vary in length from 0.16 to 0.47 mm. and in breadth from 0.016 to 0.08 mm. Clubs measure up to 0.48 mm. in length and 0.12 mm. in breadth. Rayed forms may measure 0.48 mm. from tip to tip.

Canal-wall spicules: (a) In the stem there are spindles from 0.56 to

1.12 mm. long, from 0.11 to 0.16 mm. broad, with few simple spines on the surface; smooth, flat, striated rods; and three-rayed forms with a few blunt teeth on the edges.

(b) In the stalk there are spindles with a few spines and a very large number of smooth, flat, striated forms, with blunt teeth on the edges. Measurements are on an average about the same as in stem canal walls.

Colour—Stalk, stem and branches creamy-white; polyp-stalks, in their lower portions, speckled with red, in their upper portions slightly deeper red; polyp-spicules for the most part deep red, a few colourless; polyps semi-transparent to white.

Locality: Andamans.

Dendronephthya pellucida, Henderson.

The colony is almost complete, wanting only a few branches; it measures 5.6 cm. in height and 4.1 cm. in maximum breadth.



Fig. 46. *D. pellucida*.

The short stalk is flabby, somewhat damaged, granular in appearance and about 1 cm. long.

The polyparium is oval in outline and greatly flattened in one plane. It consists of a large number of branches which increase in size towards the upper part of the polyparium. The arrangement of spicules on the stem is very characteristic, producing a peculiar network appearance; this arrangement disappears in the branches, where the spicules tend to run parallel to the length of the branch.

The polyps are arranged in small groups of three to thirteen, but five to nine are the common numbers. The groups are arranged in larger groups in which all the polyps are so placed that they reach the surface of the polyparium. The surface of the larger groups is almost flat. The heads are low and oval, measuring on an average 0.48 mm. high and 0.56 mm. broad. They are placed at an obtuse angle on short stalks of about 0.5 mm. The spicules are arranged in the following manner: There are eight double rows in each of which there are four to five pairs of converging spicules which are colourless and meet at an acute angle; below the lateral double rows a number of red spicules may run parallel to the base of the polyp. The polyp-spicules average 0.24 mm. in length.

The Stützbündel is only moderately developed, and consists of a number of spicules which average about 1.6 mm. in length in the largest. One or two of them may project for a short distance beyond the polyp.

Cortical spicules : (a) In the stem there are spindles, straight or curved, with numerous simple spines, averaging about 1 mm. in length and about 0.05 mm. in breadth ; also a number of smaller similar spindles of 0.6 mm. average length.

(b) In the stalk there are numerous three- and four-rayed and irregular forms, spindles with a marked development of strong spines along one side, others with very marked stump-like branches projecting from the less spiny side, and a third series with a tripod arrangement of branches at one end. All these are covered by numerous very prominent, simple or branched spines. Many of the irregular forms are markedly striated on the flat surfaces. The spindles average about 0.4 mm. in length, but spindles of about 1 mm. are also present.

Canal-wall spicules : (a) The stem contains flattened spindles, straight or curved, three-rayed and a number of irregular forms, all of which have small spines at least on the edges. They may be roughly divided into two lots, larger spicules which often show bifurcation at one end and average about 0.64 mm. in length and 0.03 mm. in breadth, and smaller spicules which average about 0.24 mm. in length. In addition there are numerous flat, striated spindles or rods with bluntly toothed edges ; these often show a golden glimmer and average about 0.04 mm. in length.

(b) The spicules of the stalk are similar to the preceding, but are slightly shorter and thicker, and there are fewer of them.

Colour—Stalk semi-transparent ; stem and branches almost transparent ; polyp-twigs and lower polyp-spicules deep red ; upper polyp-spicules and tentacles white. The colour of the polyps varies according to position on the polyparium, the lower part showing more white, the upper part more red in the polyps.

Locality : Andamans (J. Wood-Mason).

Dendronephthya varicolor, Henderson.

This species is represented by a small complete specimen, which measures 3.8 cm. in height and 3.3 cm. in greatest breadth.

The stalk is short, 0.9 cm. in length, flabby and greatly shrivelled owing to the thin canal walls. It gives off from its base a large number of thin-walled stolons to which fragments of shells are attached. It is semi-transparent to whitish in colour and granular in appearance in its lower portion.

The polyparium is oval, regular in outline, and greatly flattened in one plane. Two large branches are given off from the stem in the plane of flattening and then the stem rises for a short distance and divides into three main branches. The branches are nearly of equal dimensions, they are short,

rounded and thick, and give rise by repeated division to the polyp-bearing twigs. From the general surface of the stem small branches also arise.

The polyps are arranged in groups of four to twelve, which are again arranged in larger groups, the surface of which is either flat or slightly convex. They are low and oval, measuring from 0.32 to 0.64 mm. in height and from 0.48 to 0.8 mm. in breadth, and are placed at a very obtuse angle on the stalks which measure up to 1.2 mm. in length. The spicular arrangement differs



Fig. 47. *D. varicolor*.

slightly so that there are two types present.

In all there are eight double rows in each of which there are seven to eight pairs of converging spicules, and in addition a few at the base placed more or less horizontally.

In one series the third pair of converging spicules in each double row is larger than the rest, and projects beyond the polyp, one of each pair being larger than the other.

In the other there are no projecting spicules. The polyp-spicules are spindles and average 0.24 mm. in length and 0.02 mm. in breadth, while the projecting spicules may reach a length of 0.56 mm. and a breadth of 0.06 mm. In the other polyps the spicules vary from 0.16 to 0.24

mm. in length and average about 0.016 mm. in breadth.

The Stützbündel is well developed, and consists of a number of large spindles which may reach a length of 1.8 mm.; one or two may project 0.8 mm. beyond the polyp.

Cortical spicules: (a) In the stem there are long spindles, either straight or curved, and having small simple spines on their surface, and often bifid at one end. They vary in length from 0.4 to 1.6 mm. and in breadth from 0.048 to 0.096 mm.

(b) In the stalk the spicules are spindles, three- and four-rayed forms, irregularly branched rods or spindles, all with numerous prominent spines on the surface. The spindles vary from 0.16 to 0.8 mm. in length and from 0.04 to 0.11 mm. in breadth. Several of the four-rayed forms have three of the rays arranged tripod-like, while the fourth stands straight up from the junction of the other three.

Canal-wall spicules: (a) In the stem there are spindles and a few small, flat, striated forms. The spindles are long, slender, with simple spines on the surface, and measure from 0.16 to 1.9 mm. in length and from 0.032 to 0.11 mm. in breadth.

(b) In the stalk the spicules are spindles and a few four-rayed forms. The spindles are either straight or curved and have few simple spines, and vary from 0.24 to 0.4 mm. in length and from 0.048 to 0.08 mm. in breadth. In the four-rayed forms two of the rays lie in a plane at right angles to the plane of the other two.

Colour—The stalk, stem and branches are yellowish-white to white; the polyp-stalks white on the lower branches, brownish-red on the upper; the lower polyp-spicules white on the lower branches, red on the upper; the upper polyp-spicules white in all polyps.

Locality: Andamans.

Dendronephthya variata, Henderson.

This species is represented by a small, bush-shaped colony, measuring 3.5 cm. in height and 2.5 cm. in greatest breadth, and characterised by the broad deep fringe formed by the lower branches.

The stalk is 1.3 cm. in length, fully one-third of the total height. It is slender and expands a little towards its upper end, while at the lower end it is greatly contracted and gives off a number of slender stolons.

The polyparium is oval in shape with its long axis inclined at an angle to the axis of the stalk, and is flattened, one side more than the other. The lower part of the polyparium is formed of small branches which arise directly from the stem, and both stem and branches are deep red in colour. Directly above this there is an abrupt change to white and also a division of the stem into two parts, one of which is itself divided. From the surface of these principal branches smaller branches arise in every direction and are cylindrical in shape, and by repeated division give rise to the polyp-bearing twigs. The upper part of the polyparium is characterised by the white colour which has streaks and splashes of red on it, mostly on the polyps, polyp-stalks and twigs.

The polyps are arranged in small bundles of four to seven on stalks of about 1 mm. in length, and are arranged in distinct umbels on the upper part, but in somewhat divaricate fashion below. They stand at right angles to obtuse angles on the stalks, and are small flat ovals, measuring 0.42 mm.

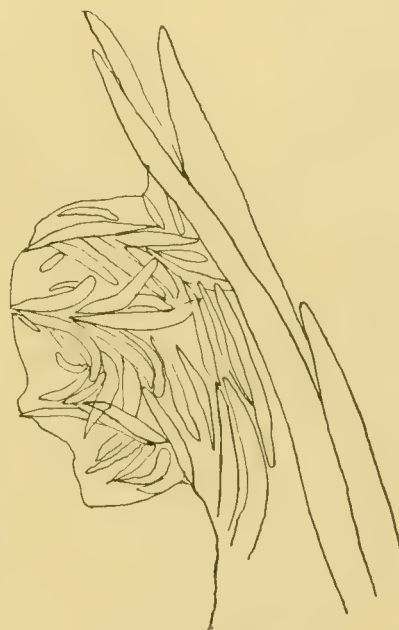


Fig. 48. *D. variata*.

in length and 0.54 mm. in breadth. The spicules are arranged in eight double rows in each of which there are five to six pairs of converging spicules; the uppermost pair in each row are slightly larger than the others and project a little beyond the polyp. The polyp-spicules are spindles with few short, simple spines and measure on an average 0.30 mm. in length, the uppermost are 0.36 mm. in length and project 0.12 mm. beyond the polyp.

The Stützbündel is well developed, and contains several large spicules of which two to three always project beyond the polyp, and may measure up to 3.3 mm. in length and project 0.6 mm.

Cortical spicules: (a) In the stem there are long spindles with few inconspicuous blunt spines, and in addition a few very small irregular spindles. The spindles vary from 0.48 to 2.4 mm. in length, and from 0.06 to 0.15 mm. in breadth.

(b) In the stalk there are spindles, clubs, three-rayed forms and irregular three-rayed forms, all covered with numerous large, rough, prominent, branched thorns. The spindles measure about 0.36 mm. in length.

Canal-wall spicules: (a) In the stem there are stringy spindles with very few spines, measuring on an average 0.36 mm. in length and 0.04 mm. in breadth. In addition there are numerous small, stringy, flattened spindles or rods with toothed edges, which measure from 0.03 to 0.15 mm. in length and about 0.001 to 0.019 mm. in breadth.

(b) In the stalk there are numerous spindles similar to those of the stem canal-walls, but on the whole slightly larger. There are also spindles, three- and four-rayed forms, with slightly more numerous spines. These latter give the following measurements: Spindles 0.6 mm. long by 0.12 mm. broad; three-rayed 0.6 mm. by 0.42 mm., and the four-rayed 0.72 mm. by 0.48.

Colour—The stalk is white in its lower half, red in the upper half; the stem, branches and polyp-spicules of the lower part of the polyparium deep red; the stem and branches of the upper part of the polyparium white with splashes and streaks of red, while in many parts the polyp-stalks and polyp-spicules are red; the polyps of the whole polyparium white.

Locality: Andamans (J. Wood-Mason).

Dendronephthya harrisoni, Henderson.

The colony is bush-shaped and measures about 7 cm. in height and 3.5 cm. in maximum width.

The stalk is long and slender, greatly ridged and wrinkled, and gives off from its base a large number of slender stolons. In texture it is somewhat leathery.

The polyparium is a little irregular owing to the loss of one of the upper

branches, but it is roughly oval with its long axis coinciding with the stem. One of the sides is almost flat and has the smaller number of branches, while the other side is markedly convex, with numerous branches, and an even surface owing to the polyps all reaching the same level. The branches arise somewhat irregularly, at times apparently in a whorl, and are almost all of equal length and nearly cylindrical in the lower part; they give rise by repeated division to the polyp-bearing twigs. The lower branches are smaller than the upper, and in them the separation of the polyp-bearing twigs is more complete bringing about in this manner a more open arrangement of the polyps and also a slight flattening of the upper portions of the branches.

The polyps on the upper portion are arranged in large groups of somewhat angular outline and concave surface. These comprise smaller groups, which in their turn are composed of a number of smaller bundles, in each of which there are from six to fifteen polyps, which stand in close contact on the short stalks of 0.5 mm. in average length. On the lower branches they stand more openly, but are still arranged in small groups. They are small and rounded in shape, about 0.48 mm. in height and in width. They are placed at an obtuse angle on the stalk and have their spicules arranged in eight double rows. In the lateral and ventral double rows there are four pairs of converging spicules, in the dorsal there are three to four pairs. Of these the uppermost pair is slightly larger than the others, but as a rule does not project. The polyp-spicules are spindles, averaging about 0.24 mm. in length and bearing a few simple spines.

The Stützbündel is well developed, and usually two spicules project beyond the polyp. These spicules may reach a length of 1.8 mm. and project for a distance of 0.42 mm. beyond the polyp, but the average is considerably less.

Cortical spicules : (a) In the stem the spicules are spindles either straight or curved, and covered with simple, blunt, regularly arranged spines. They often show a bifurcation at the end, and average in the smaller groups about 0.4 mm. and in the larger about 2.2 mm. On the stem they are arranged more or less transversely, and in the branches and twigs nearly longitudinally.

(b) In the stalk there are short, thick spindles, clubs, three-rayed and numerous flattened and irregular forms. All have numerous prominent branched spines except the flat irregular forms and flat spindles which have rough warts. The spindles measure about 1.1 mm. in length and 0.24 mm. in breadth, but there are numerous forms which vary from 0.25 to 0.9 mm. in length and from



Fig. 49. *D. harrisoni*.

0.04 to 0.12 mm. in width. The three-rayed forms measure about 0.48 mm. by 0.24 mm.

Canal-wall spicules: (a) In the stem there are spindles comparatively smooth or bearing few simple spines. They measure from 0.2 to 2.4 mm. in length and from 0.06 to 0.18 mm. in width.

(b) In the stalk there are thick spindles, three-rayed forms, golf-club and globular forms. The smaller are often of a stringy appearance, and they are all covered with blunt protuberances, either rough, blunt spines or branched warts. The spindles vary from 0.36 to 1.5 mm. in length and from 0.03 to 0.3 mm. in width.

Colour—The stalk, stem and branches are white; the twigs pinkish; the polyp-stalks generally red, but white in certain of the lower parts of the polyparium; the polyps and the polyp-spicules are white.

Locality: N. Andaman Island.

Dendronephthya booleyi, Henderson.

The specimen measures about 5.9 cm. in height and 3.8 mm. in greatest breadth.

The stalk, 2.7 cm. long, is thick but very thin-walled. From its base it gives off a number of thin-walled stolons which are often branched, and have fragments of shells attached to them. It is bluish-white to semi-transparent in colour and has a peculiar mesh-work arrangement on the surface.



Fig. 50. *D. booleyi*.

The polyparium is regular in outline, compact in appearance, oval in shape, and greatly flattened in one plane. The branching is not profuse, the stem giving off a large branch on each side in the plane of flattening and then dividing at the tip into two short, thick branches which also lie in the plane of flattening. On the other two sides and on the lower portion of the stem all round there are also small, short branches. The branches divide into short,

thick, secondary branches, which divide into blunt lobes on which the polyps are borne.

The polyps are arranged in groups of four to nineteen, but groups of eight to twelve are most usual, and these again are arranged together to form larger groups in which the polyps all practically reach the same level, thus giving a

flat or slightly concave upper surface to the group. They measure 0.4 mm. in height and 0.52 to 0.72 mm. in breadth and are placed at a very obtuse angle on stalks which measure up to 0.8 mm. in certain cases. The spicules are arranged in eight double rows in each of which there are five to seven pairs of converging flat spindles, about 0.3 mm. in length and 0.03 mm. in breadth.

The Stützbündel is not well developed except in a few of the polyps in each group. It forms in the majority of cases a sheath for the stalk, and consists of a number of spicules which average about 1 mm. in length and project 0.24 mm. beyond the polyp. In the other cases one or more of the spicules may reach a length of 2.4 mm. and may project 0.9 mm. beyond the polyp.

Cortical spicules : (a) In the stem the spicules are long, slender, straight or curved spindles with numerous smooth spiny processes, and a few flat, smooth, striated stars and rods. The spindles vary in length from 0.35 to 2.1 mm. and in breadth from 0.03 to 0.16 mm. The flattened forms may reach a length of 0.12 mm. In the stem and branches the spicules are arranged more or less transversely, but in the smaller twigs they tend to run parallel to the length of the twig.

(b) In the stalk the spicules are spindles, clubs, three- and four-rayed forms, all covered with numerous simple, sharp spines. The spindles vary from 0.32 to 1.6 mm. in length and from 0.08 to 0.1 mm. in breadth, the clubs are 0.7 mm. long and 0.13 mm. broad, and the three- and four-rayed vary from 0.64 to 0.8 mm. in length from tip to tip.

Canal-wall spicules : (a) In the stem the spicules are long, slender, straight or curved spindles with few small, smooth spines on the surface, and in addition a few small flat rods. The spindles vary in length from 0.4 to 1.6 mm. and in breadth from 0.03 to 0.08 mm., the flattened rods varying from 0.08 to 0.24 mm. in length and from 0.01 to 0.03 mm. in breadth.

(b) In the stalk the spicules are straight or curved spindles and three-rayed forms, all with simple spines on the surface, and a very few smooth, flat rods. The spindles vary from 0.32 to 0.6 mm. in length and from 0.06 to 0.09 mm. in breadth, and the three-rayed forms measure from 0.8 to 0.9 mm. from tip to tip.

Colour—The stalk is white to translucent; the stem and branches white; the twigs white on the lower, pinkish-white on the upper part of the polyparium; the polyps dark red in the lower, paler in the upper part of the polyparium; the tentacles whitish to translucent. In several parts the polyp-spicules are not red, so that the whole polyp is of a white colour.

Locality : Andamans (G. H. Booley).

Dendronephthya albogilva, Henderson.

The colony is small, round, compact, with a slightly flattened, ball-shaped polyparium, which with its creamy-white colour presents a striking contrast to the reddish stalk. It measures fully 4.5 cm. in height and has a maximum breadth of about 3 cm.

The stalk is 2.5 cm. in length, fully half the total height, rigid, leathery in texture and granular in appearance. Its upper portion is covered by the reflexed lower branches, and at its base it gives off a few short, thick stolons.

The polyparium is small, rounded, flattened, and shows three very short, blunt protuberances at the upper end. All the branches are of nearly the same

length, and are cylindrical in the lower part; by repeated division they give rise to the polyp-bearing twigs. In the upper half of the polyparium the smaller branches and twigs remain cylindrical in shape, but in the lower half the division is either imperfectly carried out, thus giving rise to a flat upper portion with short lobes at the end, or if the division is carried out, the smaller branches and twigs are slightly flattened. The stem rises almost to the tip without giving off any large branches, but just below the tip it gives off one or two and then divides into principal portions which are very short but still give rise to numerous small branches similar to those on the lower part of the polyparium, and also produce the blunt protuberances at the top. All the branches on the stem stand at a right angle except those at the lower end which are bent downwards towards the base; those that arise from the principal branches stand at an acute angle.

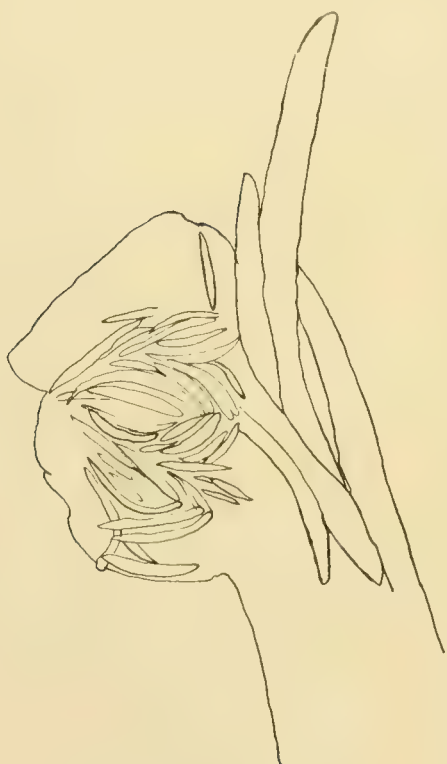


Fig. 51. *D. albogilva*.

The polyps are arranged in bundles of four to twelve, which generally stand close together, though more spread out on the lower part of the polyparium. They are small, measuring 0.5 mm. in height and 0.6 mm. in breadth, and are placed at an obtuse angle on stalks about 1 mm. long. The spicules are arranged in eight double rows in the following manner: In each lateral row there are five to six pairs of converging spicules, of which the uppermost pair may be larger than the rest and project a little beyond the polyp, and in each dorsal row there are three to four pairs. The spicules are slightly

flattened spindles and vary from 0.15 to 0.27 mm. in length. On the aboral surface of each tentacle there are two rows of small spicules.

The Stützbündel is well developed, forming a sort of sheath to the back of the polyp-stalk and having spicules which measure up to 3.0 mm. in length. Two in each bundle always project beyond the polyp, one for 1.2 mm.

Cortical spicules: (a) In the stem there are straight or curved spindles and a few V-, L- and Y-shaped forms, all having numerous regularly arranged, simple or branched warts. The spindles measure up to 3.0 mm. in length and 0.4 mm. in breadth. There are also smooth, flat, spindle-shaped to irregular star-shaped forms. They have an irregular transverse arrangement on the stem and principal branches, but tend to lie more longitudinally in the smaller branches and twigs.

(b) In the stalk there are straight or curved spindles, clubs, three-rayed forms, triangular and oval-shaped and irregular forms, all thickly covered with regularly arranged rough and often branched warts. The spindles average about 1 mm. in length and 0.27 mm. in breadth. In addition there are flat, spindle- to star-shaped forms with very few warts. Among the irregular forms there are almost globular forms, irregular spindles, and dumb-bell-shaped forms with two whorls of rough warts and a short free space, irregular star-shaped forms, and a few spherical forms that rise on the top of a tripod-like arrangement of short processes.

Canal-wall spicules: (a) In the stem there are large spindles, three- and four-rayed forms. The spindles measure from 0.8 to 3.0 mm. in length and from 0.24 to 0.48 mm. in breadth, and are covered with numerous rough warts. The three-rayed forms measure about 1.8 mm. by 1.2 mm. and the four-rayed forms about 0.48 mm. by 0.42 mm.; both have rough warts. In addition there are small, smooth, irregular, spindle-shaped bodies.

(b) In the stalk there are thick spindles, three-, four- and five-rayed forms, four-rayed forms in which one of the rays rises in a plane at right angles to that of the other three, and six-rayed forms in which two rays rise at right angles to the plane of the other four, one on each side. There are all shapes of three- and four-rayed forms; in the latter two of the rays may be quite close together and the other two widely divergent, in the former the shape often approaches a T. All are covered with multituberculate to branched warts. In addition there are smooth, flat, spindle-shaped to star-shaped forms. The rough spindles average about 1.8 mm. in length and 0.48 mm. in breadth.

Colour—The stalk is bright pink; the stem light orange-yellow; the remaining parts white.

Locality: Andamans.

Dendronephthya lanxifera, Holm.

To this species we refer a greatly damaged incomplete specimen. The outline of the polyparium seems to have been oval.

From the whole surface of the stem and branches smaller branches are given off which by repeated division give rise to the polyp-bearing twigs. All the upper branches are cylindrical, but the lower branches show a slight flattening in the lower part, and the terminal twigs are a little thickened towards the ends.

The polyps are arranged in groups of about fifteen each, and several of these may be grouped together, owing to the short terminal twigs, into a large somewhat angular bundle whose surface is either flat or slightly concave. The polyps stand in close contact with one another, measure on an average about 0.5 mm. in height and the same in breadth, and are placed at an obtuse angle on the stalks which are about 1 mm. long. The spicules form eight double rows in each of which there are six to seven converging pairs, the uppermost pair not larger than the rest, although their tips may be seen beyond the polyp-head. They measure from 0.18 to 0.30 mm. in length and are furnished with few spines. On the aboral surface of each tentacle there are two densely packed rows of small, flattish, toothed spindles about 0.06 mm. in length.

The Stützbündel is well developed, especially in the outer polyps of each bundle, where one of the spicules may reach a length of 2.5 mm. and project 0.6 mm. beyond the polyp.

Cortical spicules: (*a*) In the stem there are spindles either straight or curved, having regularly arranged, simple to branched warts, and varying from 0.36 to 1.5 mm. in length and from 0.06 to 0.15 mm. in breadth. Many of the spindles show a bifurcation at one end.

Canal-wall spicules: (*a*) In the stem canal walls there are numerous flattened spindles and three-rayed forms, which average about 0.5 mm. in length and 0.15 mm. in breadth.

Colour—The stem and branches are whitish to semi-transparent; the twigs white; the polyps white, except for the outer polyps of the bundles, which are red.

Locality: Andamans, 15 fathoms.

This species is also represented by a fragment of a colony, or it may be by a small colony of which the basal part is wanting.

It consists of a few branches which are more or less cylindrical in shape and give rise to large groups of polyps. Each group is about 7 mm. in diameter, and consists of a number of small bundles which stand on short twigs and have their margins marked by a ring of deep red-coloured polyps. The groups may appear larger owing to one or two being in close contact with one another. The

upper surface of the group is almost flat, but sometimes shows a slight convexity, and the outline of the group is more or less angular. The twigs show a peculiar thickening.

The polyps are small, roundish bodies, measuring 0.54 mm. in height and 0.6 mm. in breadth, and stand at right angles to the short stalks (only 0.5 mm.). The spicules are arranged in eight double rows of seven to eight pairs of small converging spicules. They are small and thick, measuring about 0.21 mm. in length, and do not project.

The Stützbündel is well developed, especially in the red-coloured polyps, where one of the spicules may project for a distance of 0.9 mm. beyond the polyp, and usually the tips of two more project.

The spicules of the cortex of the stem are straight or curved spindles covered by regularly arranged blunt spines.

These features, which agree closely with the description given by Kükenthal and Holm, justify the inclusion of this fragment in the species *D. lanxifera*, Holm.

Locality: Andamans, 20 fathoms.

The species has been previously recorded from Port Darwin, North Australia.

***Dendronephthya lanxifera*, Holm, var. *palkensis*, Henderson.**

This variety is represented by six small specimens, all of which are evidently young colonies, varying not only in size but also in the general shape and appearance of the polyp-bearing portion. The description given here is taken from the largest specimen.

The whole specimen is soft and flabby, measuring 3.9 cm. in height and 2.7 cm. in greatest breadth. The polyp-bearing portion is very loose and open, and is roughly oval in outline and flattened in one plane.

The stalk, 1.1 cm. long, is soft and flabby. It gives off a number of stolons from its base, and gradually widens out towards its upper end.

The polyparium is very loose and open, roughly oval in shape, and consists of a number of branches which arise from all sides of the stem. The largest branches are given off on opposite sides in one plane. The branches give rise by division to the polyp-bearing twigs.

The polyps are arranged in groups of two to nine, and these again into larger groups which are not at all regular, some forming a compact group with a more or less flat surface, others forming very loose groups with an irregular surface. The polyps are round, 0.56 mm. high and 0.48 mm. broad. They are placed at a very obtuse angle on the stalk which may reach a length of 1 mm. The spicules are arranged on the polyp in eight double rows, laterally of six pairs, dorsally and ventrally of five pairs of converging spicules. They have

an average length of 0.32 mm. and breadth of 0.032 mm. Here, one may say, there are two types of polyps, one with spicules usually colourless or the lower spicules only very faintly tinged with pink, the other with the upper spicules colourless and the lower a deep brick red. In the latter the spicules are on the whole slightly larger and tend to project beyond the polyp and also project more through the wall of the polyp, giving it a rougher appearance.

The Stützbündel consists of a number of spicules of an average length of 1.12 mm., two or more of which may project for a very short distance beyond the polyp-head.

Cortical spicules : (a) In the stem the spicules are spindles, either straight or curved, with few small spines on the surface ; they vary from 0.16 to 1.6 mm. in length and from 0.032 to 0.11 mm. in breadth. They are arranged irregularly on the stem and branches but tend to lie more parallel to the length in the smaller branches and twigs.

(b) In the stalk there are spindles, clubs, branched and four- and five-rayed forms, and a large number of small irregular spindles and stellate forms. In all there is a very large development of huge spines either simple or branched. On the spindles the spines are often greatly developed along one side and poorly on the other. Spindles vary in length from 0.32 to 1.12 mm. and in breadth from 0.048 to 0.12 mm. Clubs average 0.4 mm. in length.

Canal-wall spicules : (a) In the stem there are simple spindles with very few spines ; they vary from 0.16 to 0.72 mm. in length and from 0.048 to 0.064 mm. in breadth.

(b) In the stalk there are spindles similar to those in the stem canals but more numerous and slightly thicker. They vary in length from 0.16 to 0.7 mm. and in breadth from 0.048 to 0.11 mm.

Colour—Stalk, stem, branches and twigs semi-transparent to faint yellowish-white ; polyp-stalks white, with a slight tendency to become reddish in their upper part in some cases ; polyps whitish ; polyp-spicules reddish in a few cases, but usually colourless.

Locality : Palk Straits.

Dendronephthya lanxifera, Holm, var. *andamanensis*, Henderson.

In this specimen, which measures 3.7 cm. in height and 4.3 cm. in greatest breadth, the stalk is wanting.

The polyparium is flattened in one plane, oval in shape with the long axis at an angle to the stem, not regular in outline but with an almost unbroken surface. The branching is not profuse and the main stem rises only a short distance before it divides into two large main divisions one of which is slightly larger than the other. In the same plane as these two, and almost at the

same level, a third large branch is given off. The large branches are short and thick and divide into smaller branches which by their division give rise to the polyp-bearing twigs. From the surface of the stem similar small branches are given off. The lower branches are slightly flattened but are not reflexed.

The polyps are arranged in groups of five to eleven and these again into larger groups, which have a flat upper surface. The polyps are high, rounded, oval bodies, measuring 0.52 mm. in height and 0.64 mm. in breadth and are placed at an obtuse angle on the stalk which may reach a length of about 1 mm. The spicules are arranged in eight double rows in each of which there are six to seven pairs of converging spicules; in addition there are a few placed almost horizontally at the base, and in the space between the double rows there are usually one or two spicules which run parallel to the upper spicules in each double row. They are flattened spindles, usually curved, with few small spines on the surface, and measure on an average about 0.24 mm. in length.

The Stützbündel consists of a number of spicules which form a sheath for the back of the polyp-stalk. The spicules average about 1.6 mm. and scarcely project beyond the polyp-head. In a few the spicules may reach 1.9 mm. in length and project for a distance of 0.32 mm. beyond the polyp-head.

Cortical spicules: (a) In the stem there are straight or curved spindles covered with numerous blunt rough spines, and often showing a branching at one end, which produces Y- and X-shaped and tripod-like forms, and forms in which the branches run in close contact throughout their whole length. The spindles vary from 0.48 to 1.9 mm. in length and 0.06 to 0.17 mm. in breadth; the Y- and X-shaped forms vary from 0.6 to 1.6 mm. in length and the tripod forms measure about 1.4 mm. in length.

Canal-wall spicules: (a) In the stem canals there are short thick spindles either straight or curved, a few three-rayed forms, both series bearing blunt spines on the surface, and a large number of flat, smooth, striated forms with blunt teeth on the edges. The spindles measure from 0.48 to 0.68 mm. in length and from 0.12 to 0.14 mm. in breadth; the three-rayed forms may reach a length of 0.68 mm.; and the flat, smooth forms vary from 0.08 to 0.24 mm. in length and have an average breadth of 0.017 mm.

Colour—The colour of the whole is white to semi-transparent, but several of the polyps in each group have red spicules which are so arranged that the larger groups have a fringe of red polyps.

Locality: Andamans (J. Wood-Mason).

Dendronephthya inermis, Henderson.

A large colony measuring 8 cm. in height and 6 cm. in breadth, with very large compact polyparium and short stalk.

The stalk measures 2.5 cm. in length, about one-quarter of the total height of the colony. It is thick and somewhat flabby, granular in appearance, and gives off from its base a large number of long, slender stolons to which are attached particles of sand and fragments of shells.

The polyparium is large, compact, solid, of oval outline and somewhat flattened; it is thicker towards the apex than at the base. It is formed of a large number of very thick short cylindrical branches which by numerous repeated divisions give rise to the polyp-bearing twigs. In the lower part of the polyparium the branches are small, much larger towards the middle, and again slightly smaller as the upper part is reached. The branches may be said to be given off in irregular whorls, but the branches of one whorl are by no means of uniform size. The main stem ends in a very blunt conical projection which shows traces of dividing into three lobes, the beginnings of three new branches, on each of which there are numerous polyps.

The polyps all come to the surface of the polyparium and are arranged in groups of six to twenty individuals each. A number of groups lie close together and form larger groups which are flat to slightly hollow in surface. These groups vary in shape from \bigcirc to \square or \triangle and are themselves grouped with other large groups, thus forming huge flat to concave, circular to angular bundles of polyps in which there are several hundred individuals. The polyps are placed on very short stalks about 0.5 mm. in length. They are small rounded bodies measuring about 0.48 mm. in length by 0.60 mm. in breadth, and standing at an obtuse angle to the stalk. The polyp-spicules are arranged in eight double rows in each of which there are six to seven pairs of converging spicules which have few spiny protuberances and measure on an average 0.21 mm. in length. There are no specially large forms and none project. Two rows of spicules occur on the aboral surface of the tentacles.

The Stützbündel is not very well developed, being seen at its best on the outer polyps of each bundle, where a spicule may reach a length of 1.8 mm. and may project for a short distance.

Cortical spicules: (a) Those of the stem are slender spindles, straight or curved, covered with regularly arranged roughened warts. They vary from 0.33 to 3.0 mm. in length, and from 0.03 to 0.18 mm. in breadth. They are irregularly arranged, producing a stringy appearance.

(b) Those of the stalk include numerous spindles, clubs, tri- and tetra-radiate forms, and also irregular spindles or stars. They are covered by irregularly arranged, pointed or blunt, large rough thorns. The spindles measure up to 0.6 mm. in length.

Canal-wall spicules: (a) The stem contains large spindles of a peculiar stringy appearance, with very few blunt, thorn-like projections, and numerous

small, flat, smooth, irregular spindles. The larger vary from 0.36 to 2.2 mm. in length, and from 0.06 to 0.15 mm. in breadth.

(b) The stalk contains spindles, three-rayed and tripod forms. All are covered with very rough branched warts. Several of the spindles show a division into two or three parts at one end. Spindles average 0.72 mm. in length by 0.09 mm. in breadth. The three-rayed forms, which may have a ray divided into two or three, measure up to 0.6 mm. in length, and the tripods 0.48 mm. There are in addition small, flattened, irregular spindles.

Colour—Stalk, stem and branches white to semi-transparent (or bluish-milky-white); polyps white with pinkish-red spicules at the base; Stützbündel pinkish-red, that colour predominating more on the outer polyps.

Locality: Padaw Bay (Dr. Anderson).

Dendronephthya quadrata, Henderson.

This species is represented by a complete specimen which measures 5.6 cm. in height and about 3.7 cm. in greatest breadth.

The stalk is short, 2 cm. in length, thick and rigid, and gives off from its base a number of stolons. It is marked by a number of rings and has a wavy appearance.

The polyparium is large, greatly flattened in one plane, almost regular in outline, and with an even unbroken surface. It is more or less quadrilateral in shape with the corners rounded off and the sides slightly irregular, and consists of a number of branches which vary little in size, the upper being slightly the longer, and are most developed in the plane of flattening. The branches are short and thick, and by repeated division give rise to the blunt stump-like polyp-bearing twigs. In addition to the larger branches numerous smaller branches arise on the lateral surface of the stem.

The polyps are arranged in groups of four to twenty, and these again into still larger groups. In the groups all the polyps reach the same level so that the larger groups have a perfectly level or slightly concave surface.

They are rounded bodies measuring 0.48 mm. in height and 0.64 mm. in breadth, and are placed at a very obtuse angle on the stalk which varies greatly in length and may reach about 0.6 mm. in length. The spicules are arranged in eight double rows in each of which there are five pairs of converging spicules, the uppermost pair of each row being slightly larger than the others. There are also a few transversely placed spicules at the base. The spicules are straight



Fig. 52. *D. quadrata*.

or curved spindles with few small spines on the surface, the lower measuring on an average 0.19 mm. in length and 0.017 mm. in breadth, while the upper have an average length of 0.25 mm. and breadth of 0.019 mm.

The Stützbündel forms a sheath for the back of the polyp-stalk and consists of a number of spindles which average 1.12 mm. in length. Two or three may project as a small blunt conical point beyond the polyp-head.

Cortical spicules: (*a*) In the stem there are straight or curved spindles with numerous simple blunt spines, and varying in length from 0.25 to 1.6 mm. and in breadth from 0.016 to 0.16 mm.

(*b*) In the stalk there are straight or curved spindles, often branched at one end, where the branches vary in number from two to six, and irregular rod- to spindle-shaped forms. All are thickly covered with numerous large simple to branched spines. The spindles vary in length from 0.24 to 1.36 mm. and in breadth from 0.048 to 0.08 mm.

Canal-wall spicules: (*a*) In the stem the spicules are smooth, flat, striated rods with blunt teeth on the edges. They measure from 0.048 to 0.12 mm. in length and from 0.013 to 0.03 mm. in breadth.

(*b*) In the stalk the spicules are similar to those of the canal walls of the stem but slightly larger.

Colour—The stalk, stem and branches are white to greyish-white; the upper portion of the polyp-stalks red, the polyp-spicules white.

Locality: Andamans.

Dendronephthya ochracea, Henderson.

The specimen is almost complete, wanting only a small branch at the tip; it is egg-shaped, with the long axis of the egg at an angle to the stalk; it measures 4.7 cm. in height and 4 cm. in maximum breadth.

The stalk, 2.5 cm. long, is thick and rigid, and gives off a number of thick-walled stolons from its base. It is granular in appearance and is marked in its lower portion by transverse, in its upper portion by longitudinal, ridges and furrows.

The polyparium is oval in outline and very compact; it consists of a number of branches which are arranged in imperfect whorls round the stem. There is a slight flattening in one plane due to the greater development of the branches in that plane. The branches are cylindrical and give rise by repeated division to the polyp-bearing twigs; they stand at a right angle to the stem, and in one of the lower branches there is a slight flattening of the lower portion.

The polyps are arranged in groups of three to ten, groups of seven and eight occurring most frequently. These groups stand apart from one another, so that no larger groups are formed. All the polyps reach the surface of the polyparium thus giving it a compact appearance. The heads are low and oval,

measuring on an average 0.48 mm. in height and 0.72 mm. in breadth. They stand at a right angle to the stalk, which measures up to 1.25 mm. in length. The spicules are arranged in eight double rows in each of which there are five to six pairs of converging spicules; the uppermost pair in each row is slightly larger than the others and projects a short distance beyond the polyp. The spicules are flattened spindles, straight or curved, with few spines, averaging 0.19 mm. in length, the uppermost pair being up to 0.24 mm. long. There are a few large spicules arranged irregularly at the base of each polyp. On the aboral surface of each tentacle there are two rows of small rod-like spicules 0.017 mm. long.

The Stützbündel is well developed, and consists of a number of spindles, several of which may project beyond the polyp-head. They may reach a length of 2.4 mm. and project 0.8 mm.

Cortical spicules: (a) In the stem there are large spindles, straight or curved, thickly covered with simple to blunt spines, from 0.19 to 3.2 mm. long, and from 0.048 to 0.4 mm. broad.

(b) In the stalk there are short thick spindles, three-rayed, incipient four-rayed, short, thick rods, and numerous smaller, irregular forms. All are thickly covered by blunt, rough warts. Spindles vary in length from 0.16 to 1.12 mm. and in breadth from 0.08 to 0.22 mm. In the four-rayed forms the centre has an X-shaped mark, and in many cases two of the rays may be represented by mere stumps on the side.

Canal-wall spicules: (a) In the stem there are long spindles similar to those of the stem cortex but very few in number, varying from 0.8 to 2.4 mm. in length and from 0.16 to 0.32 mm. in breadth. There are also a very few small, flat rods with toothed edges.

(b) In the stalk there are thick spindles, three- and four-rayed forms, spindles with several branches at one end, and spindles with two branches arising together at the middle point of one side and running parallel and in close contact throughout their length. All are thickly covered by blunt, rough warts. The spindles vary in length from 0.64 to 1.6 mm. and in breadth from 0.16 to 0.32 mm. The rayed forms may reach a length of 1.2 mm. from tip to tip, and may have a breadth of 0.32 mm. in a ray.

Colour—Stalk yellowish-white; stem and branches light orange; twigs light orange streaked with red; polyps white.

Locality: Andamans (J. Wood-Mason).

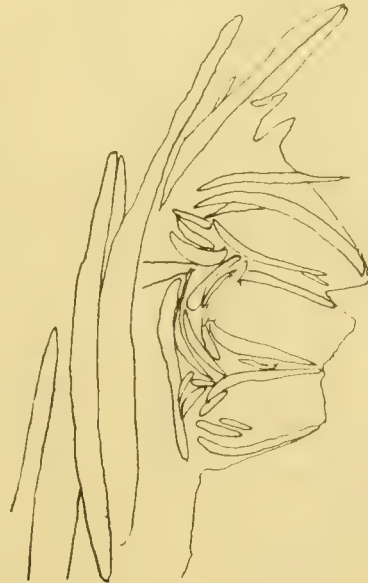


Fig. 53. *D. ochracea*.

Dendronephthya nicobarensis, Henderson.

The specimen is complete and measures about 4.5 cm. in height and 2.6 cm. in greatest width.

The stalk is thick and markedly ridged, and measures 1.4 cm. in length. It gives off a number of thin-walled stolons from its base and is granular in appearance and leathery in texture.

The polyparium is nearly cylindrical in shape, bluntly rounded at the apex ; it presents an unbroken, compact surface which all the polyps reach. The



Fig. 54. *D. nicobarensis*.

branching is not very profuse, and there is little difference in the lengths of the various branches, those about midway up the stalk being slightly longer than the others. They break up into smaller branches which in their turn divide and form the twigs on which the polyps are borne. None of the branches are flattened.

The polyps are arranged in groups of five to fourteen, and these again are arranged in larger groups. In the latter the surface is flat, or in a few cases slightly concave. The polyps are low and round, measuring from 0.32 to 0.48 mm. in height and from 0.48 to 0.64 mm. in breadth, and are placed at an obtuse angle on stalks which may be very minute or may reach a length of about 1 mm. The spicules are arranged in eight double rows in each of which there are five pairs of converging spicules. There are apparently two types of polyps, one in which the spicules are large, and in which one or both of the uppermost pair of spicules project, the other with slightly smaller spicules and neither of the uppermost projecting. The spicules are spindles and average in the smaller polyps about 0.19 mm. in length and 0.032 mm. in breadth, and in the larger about 0.21 mm. in length and 0.03 mm. in breadth, while the projecting spicules reach a length of 0.24 mm.

The Stützbündel shows the same peculiarity as in the other *Umbellatae*, being well developed and containing one or more large spicules which project beyond the polyp, or consisting of a number of smaller spicules none of which project. In the first case they measure as much as 2.2 mm. and project 0.8 mm. beyond the polyp, in the second case they average about 0.9 mm. in length.

Cortical spicules: (a) In the stem the spicules are spindles, either curved or straight, three- and four-rayed, Y- and U-shaped forms, all of which are covered with numerous blunt, thick spines. It is interesting to note that the

Y-shaped spicules are modified forms of a branched spindle, and that one or more of the arms may themselves be branched, and that they differ in appearance from the three-rayed forms where the origin of the rays is distinct. The spindles vary from 0.16 to 2.4 mm. in length and from 0.048 to 0.21 mm. in breadth; the Y-shaped spicules measure up to 1.2 mm., the three-rayed average about 0.4 mm., and the four-rayed average about 0.9 mm. in length.

(b) In the stalk there are straight or curved spindles, clubs, Y-shaped, three- and four-rayed spicules and numerous irregular forms either slightly spindle-shaped or tending more to a globular shape. All are covered with large, pointed spines. The spindles vary from 0.16 to 1.1 mm. in length and from 0.048 to 0.13 mm. in breadth; the Y-shaped forms often reach a length of over 1 mm. and the three- and four-rayed forms vary from 0.16 to 0.8 mm. in length.

Canal-wall spicules: (a) In the stem the spicules are a few thick spindles with very few small simple spines on the surface, and a number of smooth, flat, striated forms either rod-shaped with blunt teeth on the edge or three-rayed. The spindles vary in length from 0.64 to 1.6 mm. and in breadth from 0.08 to 0.19 mm.

(b) In the stalk the spicules are short, thick spindles, three-rayed forms with short thick rays, and numerous small, smooth, striated forms with blunt teeth on the edges. The spindles and three-rayed forms have a number of large prominent spines on the surface. The spindles vary from 0.32 to 0.8 mm. in length and from 0.11 to 0.14 mm. in breadth, and the smooth, striated forms vary from 0.048 to 0.16 mm. in length and from 0.016 to 0.08 mm. in breadth.

Colour—The stem, stalk and branches are white; in the upper part of the polyparium the polyp-stalks are usually deep red, in the lower part they are white, while in a peculiar band which runs in a curve from the base of the polyparium to the tip, they are faint red; the polyp-spicules white; the tentacles semi-transparent.

Locality: Nicobars (F. Stoliczka).

Dendronephthya rubeola, Henderson.

To this species is referred a complete specimen measuring 5.7 cm. in height and 4.2 cm. in greatest breadth. It is characterised by the loose, open arrangement of the polyparium, and the contrast between the white polyps and the deep red branches.

The stalk is 3 cm. long, much shrivelled, and marked by a number of longitudinal grooves and ridges. It is thick at the base, where it gives off a few stolons, and gradually tapers upwards; it is granular in appearance, leathery in texture and tough, and has its upper part hidden by reflexed flattened branches.

The exact shape of the polyparium is difficult to determine owing to a branch or two being absent, but it is most probable that it was of a somewhat oval shape, the long axis standing at right angles to the stalk. In arrangement it is very open—cylindrical branches give off smaller branches which by a repeated dichotomy give rise to the polyp-bearing twigs. The lower branches,



Fig. 55. *D. rubeola*.

two in number, are flattened, leaf-like structures which surround the stem and are reflexed, thus forming a collar for the upper portion of the stalk. From the upper surface of these flattened branches two large cylindrical branches are given off.

The polyps are arranged in small groups of four to eleven, these groups not being massed into larger ones, but standing apart from one another at the ends of the branches, all the members of a group reaching practically the same level. They are low and round, 0.48 mm. high, 0.64 mm. broad, and are

placed at an obtuse, often at a nearly right, angle on the short stalk (about 0.5 mm.). The spicules are small and very numerous and are arranged in eight double rows each containing numerous (at least nine) pairs of converging spicules. They form a complete casing for the polyp and average 0.17 mm. in length, and 0.032 mm. in breadth. On the aboral surface of the tentacles there are two rows of flat spindles whose ends alternate with one another.

The Stützbündel is well developed, although it is only in a few polyps of each group that it attains its maximum growth. It consists of a number of spicules which form a sheath for the stalk and average 1.1 mm. in length, scarcely, if at all, projecting beyond the polyp. In a few cases the spicules are 2.7 mm. long and project for a distance of 0.8 mm.

Cortical spicules: (a) In the stem there are slender spindles, straight or curved, with small simple spines, from 0.24 to 2.2 mm. long, from 0.032 to 0.14 mm. broad, colourless to faint brick-red in colour, and in a few cases bifid at one end.

(b) In the stalk there are spindles, clubs and numerous irregular forms, either fusiform, globular or radiate. All are covered by numerous, large, simple or branched spines. Spindles are from 0.24 to 1.2 mm. long and from 0.08 to 0.16 mm. broad. The spines are often largely developed along one side throughout its length.

Canal-wall spicules: (a) In the stem the spicules are spindles with few

inconspicuous spines; they vary from 0.32 to 1.4 mm. in length and from 0.032 to 0.16 mm. in breadth.

(b) Those of the stalk are similar to those of the stalk cortex.

Colour—Stalk pure white; stem and main branches yellowish-white streaked with red, gradually becoming deeper red; secondary and smaller branches and twigs bright coral-red; polyps pure white.

Locality: Andamans.

Dendronephthya agaricoides, Henderson.

This specimen is characterised by its peculiar plate-like appearance and the arrangement of its branches. Its total height is 1.5 cm.

The stalk, about 1 cm. long, is thick, much ridged and wrinkled, and has had a broad flat base of attachment.

The polyparium is flat and spreading, and may be compared to a plate longer than it is broad. The upper end of the stalk expands and grows in a horizontal instead of in a vertical direction, thus producing a thin, narrow, rod-like expansion on the ends and lateral edges of which there is a fringe of branches. In addition to four lower flattened branches there are only four others, also flat, and a few small ones that arise from the upper surface of the lower branches. The latter nearly surround the upper portion of the stalk, leaving only small free spaces between them, and are flattened, leaf-like structures. The other branches are slightly flattened. After repeated divisions the polyp-twigs arise.

The polyps are arranged in bundles of seven to nine, several of which may be grouped together to form a larger bundle. The polyps of each group stand compactly together, causing the bundles to assume a club-shape. On the much-cut-up edges of the flattened branches, the polyps occur singly, or in small groups on widely divergent stalks. They measure about 0.66 mm. in height and about 0.72 mm. in breadth, and are placed for the most part at right angles to the stalk, but this is varied from acute to obtuse according to position in the bundle. The stalks, especially on the lower part, may reach over 2 mm. in length, but the average is much shorter. The spicules are arranged in eight double rows in each of which there are six to seven pairs of converging spicules; one of the uppermost pair may be much larger than the others and may pro-



Fig. 56. *D. agaricoides*.

ject beyond the polyp-head when the latter is retracted. These spindles average about 0.33 mm. in length, the longest reaching 0.63 mm. On the aboral surface of the tentacles two rows of thickly crowded, flat, irregular spicules are present, having an average length of 0.06 mm. ; they may have a few teeth at their edges or they may be perfectly free of these except for the presence of one tooth or spine near one end.

The Stützbündel is well developed on most of the polyps, one or more of its spicules projecting. One may reach a length of about 4 mm. and project a distance of 1.2 mm. ; if a second projects it is for a much shorter distance.

Cortical spicules : (a) The stem contains spindles, from 0.18 to 2.5 mm. long, from 0.06 to 0.18 mm. thick, either straight or curved, with long, prominent, smooth or branched thorns ; a number of small flat spindles and branched spindles, which have a stringy appearance and have a few simple spines or teeth on the edges ; a few large three-rayed forms and long spindles with more numerous and blunter spines. These long spindles reach a length of 3.3 mm.

(b) The stalk contains spindles 0.33 mm. in average length, irregular branched and star-shaped forms. These have numerous large branched spines which may reach a length of 0.12 mm. There are also spherical forms with prominent spines projecting on all sides.

Canal-wall spicules : In both stem and stalk, spicules seem to be quite absent, except for the presence of a few minute corpuscles in the stalk canal walls.

Colour—Stalk and flattened lower branches whitish ; stem and other branches yellowish ; terminal twigs and polyp-stalks red ; polyps white or yellow.

Locality : Gulf of Martaban, 67 fathoms.

Dendronephthya malabarensis, Henderson.

This specimen must be classed with the *Umbellatae* for the polyps are arranged in small bundles which are all raised more or less to the same level. The colony is small, 28 mm. high, 36 mm. broad, very limp, the branches hanging down and completely hiding the stalk. It is flattened in one plane and the growth is more horizontal than vertical.

The stalk appears very short owing to the position of the lower branches, but it measures 12 mm., almost a half of the total height, and under the low power presents a beautiful appearance due to the presence on the upper layer of white four-rayed spicules which contrast with the yellowish semi-transparent colour of the stalk.

The polyparium is small, very irregular in shape, flattened in one plane, and more developed in the horizontal than in the vertical plane. It consists of

a number of branches which are very slender and of different lengths, very flabby in texture, and hanging down over the stem. These branches divide into smaller branches, which divide into long slender twigs; these after one more division give rise to smaller twigs on which the polyp-stalks are placed.

The polyps are arranged in bundles of four to five individuals. These are placed on stalks less than 1 mm. in length as a rule, but one polyp of each group is raised above the level of the bundle, thus making the colony approach the divaricate type in appearance. The outstanding polyp of a group is usually given off from the side of the stalk, and in the angle thus formed a young polyp arises, thus giving the bundle a more compact appearance. The polyps have an average length of 0.54 mm. and breadth of 0.48 mm., are placed perpendicularly to the stalks, and have a more slender appearance than their measurements suggest when the tentacles are expanded. The polyp-spicules are arranged in eight double rows, in each of which there are four pairs of converging spicules, the uppermost pair projecting a little beyond the polyp. At the upper end of each double row a pair of spicules are present which lie a little apart from the double row, and are not included in the above number of pairs. The lower polyp-spicules measure on an average 0.30 mm. in length while the upper may reach a length of 0.51 mm. They have simple spines or thorns which stand at right angles to the surface. On the aboral surface of the tentacles are two loosely arranged rows of flat plate-like spicules with irregular toothed edges.

The Stützbündel is rather interesting; it consists of a few prominent spicules, one of which may project for a considerable distance beyond the polyp and measures on an average about 1.3 mm. in length; but another feature must be noticed, namely, that in several of the secondary twigs along the back there is seen a large prominent spicule which usually continues up the back of the twigs of the third order and may form part of the Stützbündel of one polyp; this spicule may have a length of 6.6 mm. and a breadth of 0.18 mm. Along the back of the terminal twigs there is usually a much smaller spicule which gives way to the Stützbündel spicules on the polyp-stalks.

Cortical spicules: (a) The stem and branches have long, slender spindles covered with simple spine-like protuberances. They are arranged very irregularly and only in the twigs take up a more or less longitudinal position. They have an average length of 2.5 mm. and vary from 0.06 to 0.12 mm. in thickness. In addition to these a few four-rayed forms are present; a number of the spindles show markedly forked ends.

(b) In the stalk there are spindles similar to those of the stem, and numerous three- and four-rayed forms; the latter are flattened, have prominent irregularly toothed edges, may measure 0.48 mm. in greatest length, and

show on their surface a peculiar pitted appearance under high power. There are also a few thicker spindles with rough warts.

Canal-wall spicules : (a) The stem is apparently quite free of spicules.

(b) No spicule was found in the stalk.

Colour—Stalk, stem and main branches yellowish-white ; twigs salmon-pink ; polyps white, but appearing pink owing to the pinkish spicules.

Locality : Station 246, off Malabar Coast, 68-148 fathoms.

Dendronephthya decipiens, Henderson.

A complete specimen measuring 4.9 cm. in height and 4.8 cm. in greatest breadth.

The stalk is very short, 1.3 cm. in length, thin-walled, with traces of stolons at the base, has a streaky appearance, is parchment-like in texture, and has its upper part hidden by reflexed lower branches.

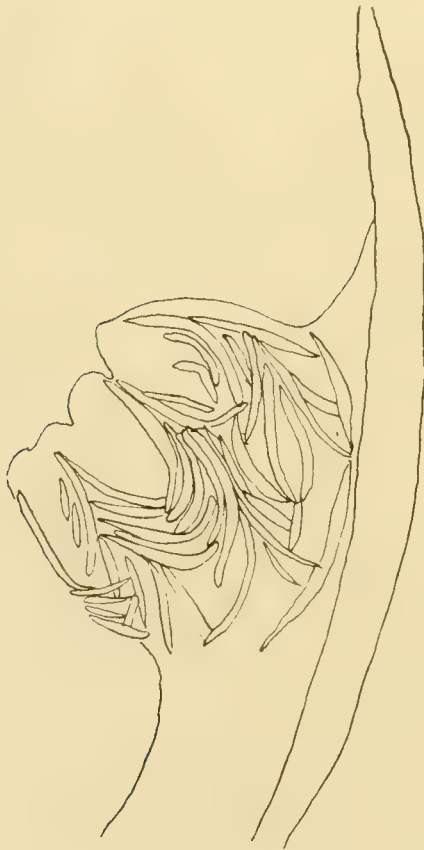


Fig. 57. *D. decipiens*.

The polyparium is greatly flattened in one plane, circular in outline, and even of surface. It consists of two main branches and a large number of secondary branches—the two principal branches being in one plane, while the smaller branches arise all round the main branches and stem. Two lower branches are large, flattened, reflexed, leaf-like structures which have a very broad base and almost completely surround the stem, leaving only two very small free spaces. Directly below one of these there is a small branch with cylindrical stalk and flattened upper portion which is slightly triangular in shape.

The polyps are arranged in groups of three to eight, and may occur singly or in small groups on the edges of the flattened branches. They are low and round, 0.56 mm. high and 0.64 mm. broad, and are placed at an obtuse angle on the stalk which has an average length of a little over 1 mm. The

spicules are arranged in two distinct ways. In the first, one to two pairs meet at a very obtuse angle, and above these rise eight double rows of three to four pairs each, the uppermost pair being largest. One spicule projects considerably. In the second the spicules meet at a more acute angle, and in the double

rows there are four to five pairs, none of which project. The spicules are flattened curved spindles, and average 0.24 mm. in length, while the projecting spicules average about 0.25 mm. in length. On the back of the tentacles there are two rows of small, flat spicules.

The Stützbündel is well developed, and consists of a number of large spicules, one of which may reach a length of 3.2 mm. and project for a distance of 2.6 mm.

Cortical spicules : (a) In the stem there are spindles either curved or straight, from 1.28 to 2.4 mm. long, from 0.08 to 0.16 mm. broad, and with few simple spines regularly arranged.

(b) In the stalk the spicules are spindles curved or straight, rods, three- and four-rayed forms, and a number of irregular shapes. All are thickly covered with large, rough, branched spines. The small spindles have an average length of 0.25 mm. and breadth of 0.048 mm., while the large average 1.5 mm. in length and 0.16 mm. in breadth.

Canal-wall spicules : (a) In the stem there are a very few spindles similar to those of the stem cortex, and a very few small, flat, smooth forms, striated and with toothed edges.

(b) In the stalk there are a few spindles similar to the preceding, and a number of small irregular stars.

Colour—Stalk, stem and branches greyish-white ; polyps reddish-brown.

Locality : Arakan Coast, 13 fathoms.

This species may also be classified with the *Diraricatae*, especially when the arrangement of the polyps on the lower branches is considered.

Dendronephthya ambigua, Henderson.

A complete specimen, greatly flattened in one plane, measuring 5.5 cm. in height and about 6 cm. in greatest breadth. Most of the polyps have been rubbed off.

The short stalk is about 2 cm. in length, greatly shrivelled and wrinkled, stringy in appearance, has traces of a few stolons at the base, which is slightly torn, and has its upper portion hidden by reflexed flattened branches.

The polyparium is loose and open, greatly flattened in one plane, and oval in outline with the long axis of the oval at right angles to the stalk. It consists of two main branches of about equal length which are given off in the same plane on opposite sides of the stem, and a large number of smaller branches which arise all round the stem and main branches and by repeated division give rise to the polyp-bearing twigs. Two of the lower branches are flattened and leaf-like, and almost surround the stem, leaving only two small free spaces between their bases. Below one of these free spaces two small branches arise with rounded lower part and flattened upper part (like an um-

brella turned outside in); below the other there is only a single such branch. Above each a somewhat similar small flattened branch is found.

So far as the specimen permits one to say, the polyps are arranged in small bundles of five to seven and may occur singly or in small groups on the edges of the flattened branches. They are fairly high and round, measuring about 0.60 mm. in height and 0.50 mm. in breadth, and are placed at a very obtuse angle on stalks which average about 1 mm. in length. The spicules are arranged in eight double rows in each of which there are four to six pairs of acutely converging spicules, the uppermost pair being larger and projecting. The lower spicules average about 0.32 mm. in length, the upper about 0.48 mm. On the aboral surface of each tentacle there seem to be two double rows of spicules, one of flat bars with ragged edges, and



Fig. 58. *D. ambigua*.

lying on the top of this a second double row of much thinner rod-shaped spicules with toothed edges.

The Stützbündel is well developed, and consists of a number of spindles, one or two of which usually project; they average about 1.6 mm. in length.

Cortical spicules: (a) In the stem and branches there are apparently two series of spicules, a larger series of spindles which may reach over 6 mm. in length, and a smaller series of spindles which average about 1.2 mm. in length. They have simple spines. The larger spicules form a rough network or lattice-work the meshes of which are filled up by the smaller spicules.

(b) In the stalk there are simple spindles, variously branched spindles, and a few irregular three-rayed forms. The spindles may have the branches near one end and so appear three-rayed, or they may be given off near the middle point of a side. The larger spindles average about 1.2 mm. in length. All are covered by numerous rough, blunt warts.

Canal-wall spicules: (a) In the stem there are simple thick spindles with few simple, inconspicuous conical spines, and a number of flat, smooth, striated irregularly branched forms.

(b) In the stalk the spicules are similar to the preceding except that there are a number of more prominent Y-shaped forms and that the warts are rougher.

Colour—Polyps and upper parts of polyp-stalks, in certain parts deep brick-red; the remaining parts, greyish-white.

Locality: Arakan Coast, 13 fathoms.

This species may be also classified with the *Diraricatae rigida* group.

Dendronephthya elongata, Henderson.

The specimen is very limp and flabby, very irregular in outline, and measures 10 cm. in height and 5 cm. in greatest breadth.

The stalk is very flabby, granular in appearance, and measures fully 2·5 cm., about one-fourth of the total height.

The first offshoots are two small branches almost directly opposite one another. After a free length of nearly 1·5 cm. the stem gives off two broad, leaf-like, reflexed branches or folds, the bases of which almost surround the stem, collar-fashion, leaving only two small free spaces which are not directly above the two smaller branches. Further, there are numerous branches of unequal length given off, making the polyparium, which is much flattened, very irregular in outline. The principal branches divide repeatedly, those of the fourth order being the terminal branches, and these give off small twigs from which the polyp-stalks arise. From the surface of the main stem small flattened branches arise of which the base is almost as broad as the flattened upper portion.

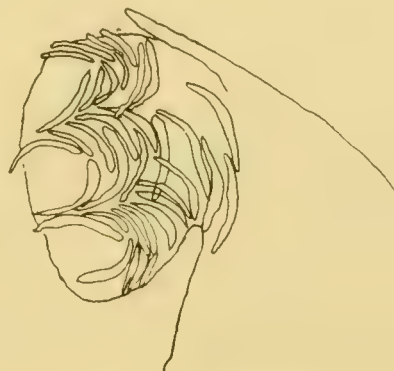


Fig. 59. *D. elongata*.

The polyps are arranged in bundles of six, all the individuals of a bundle reaching almost the same level; they also occur singly or in small groups on the edges of the flattened leaf-like branches. They measure on an average 0·54 mm. in height and 0·48 mm. in breadth, and are placed on the very short stalk at an angle which is usually a right angle, though sometimes approaching acute. There are two sizes of polyps on the specimen, the smaller polyps having a relatively shorter stalk. The polyp-spicules are arranged in eight double rows; in each of these there are five pairs of spicules, the uppermost of which may project for a very short distance beyond the polyp; these spicules are all of almost uniform length, 0·25 mm. They are flattened spindles, straight or curved, and bear simple spines.

The Stützbündel is well developed; in some cases one of the spicules has a length of 1·6 mm. and projects for a considerable distance (0·4 mm.); in others it consists of a number of smaller spicules.

Cortical spicules: (a) The stem contains spindles, straight or curved, clubs, and irregular three- and four-rayed forms. No particular arrangement can be determined, but the surface presents an appearance very much like that of a handful of chopped hay with a few larger pieces promiscuously thrown on. This appearance is continued on the branches and twigs, and only on the polyp-stalks does the arrangement become a little more regular. The spindles are slender,

from 0.48 to 1.6 mm. long, with simple prominent thorns which tend to become compound. The clubs may reach a length of 0.9 mm. but are usually smaller; they are furnished at the thick end with prominent spines. The three- and four-rayed forms are very irregular and much rougher in appearance than the spindles and clubs.

(b) In the stalk there are smaller spindles than in the stem, very irregular forms which approach stars, incomplete three- and four-rayed and globular forms, all of which are furnished with huge branched or compound spines.

Canal-wall spicules: (a) The stem has thick spindles and clubs, measuring from 0.42 to 1.2 mm. in length, and from 0.06 to 0.24 mm. in breadth. They have prominent spines.

(b) The stalk has short, thick spindles, spindles with very blunt ends or rod-shaped forms, irregular three- and four-rayed forms, and spicules which consist of a large, blunt, rounded body giving off one arm which soon divides into two parts. The rayed forms have very thick, blunt, short rays. All the forms are thickly covered with projections which vary from prominent simple spines to branched spines and prominent rough warts. The spindles are from 0.3 to 1.4 mm. long, and from 0.09 to 0.3 mm. broad. Some of the three-rayed forms have a length of 0.9 mm.

Colour—Stalk, stem and branches are whitish to yellowish, with here and there a bluish tinge; the lower flattened branches are pale lilac; the polyp-heads pinkish-red; the tentacles yellowish-white.

Locality: Off Ganjam Coast, 28 to 30 fathoms.

Dendronephthya, sp. (?)

From the Andamans there is a small specimen—a portion of a colony. It consists of a number of small branches arising from a common part.

The polyps are arranged in small groups of eight to ten, and adjacent groups are in such close contact as to give the appearance of a much larger group. They measure on an average 0.65 mm. in height and 0.6 mm. in breadth, and are placed at an obtuse angle on long stalks about 2 mm. in length. The polyp-spicules are arranged in eight double rows of six to seven pairs of converging spicules; the uppermost pair may project a little. They average about 0.24 mm. in length.

The Stützbündel is very well developed, two or three spicules projecting beyond each polyp-head, giving the colony a very thorny appearance. These spicules may project for a distance of about 0.9 mm. and may reach a length of 3.6 mm.

Cortical spicules: The spicules are simple spindles, either curved or straight, and sparsely covered by regularly arranged simple spines. They measure up

to 2.5 mm. in length and 0.15 mm. in breadth, and are arranged irregularly on the larger branches.

Canal-wall spicules : In the canal walls there are spindles and three-rayed forms, the spindles often bifurcated at one end.

Colour : The principal branch is yellowish ; the smaller branches and twigs deep orange ; the polyps white.

Locality : Andamans (J. Wood-Mason).

Dendronephthya, sp. (?)

This is a fragment, rigid in character, cylindrical in shape, and from it rise numerous smaller branches on all sides, which by repeated division give rise to the polyp-bearing twigs.

The polyps are arranged in small groups of about six, and are placed at a very obtuse angle on the stalk which measures up to 2 mm. in length. They are somewhat conical in shape, and measure 0.66 mm. in height and 0.72 mm. in width. The polyp-spicules are arranged in eight double rows, in each lateral row there are from six to eight pairs of spicules, one of the second uppermost pair being much larger than the others and projecting. The spicules are spindles either curved or straight, and average 0.24 mm. in length ; the upper may reach a length of 0.6 mm. and project 0.24 mm. beyond the polyp. They bear simple thorns which are directed obliquely towards the tip on the projecting part of the larger spicules.

The Stützbündel is well developed, one of the spicules projecting for a considerable distance (about 1 mm.) beyond the polyp, and reaching a length of 3.3 mm.

Cortical spicules : In the stem the spicules are spindles which bear numerous regularly arranged, blunt, rough to branched warts. They vary from 0.42 to 3.6 mm. in length and from 0.09 to 0.27 mm. in width. There are, in addition, numerous smaller spindles with fewer warts. They form a network on the principal portion, but are more longitudinally arranged on the smaller branches and twigs.

Canal-wall spicules : In the stem there are spindles.

Colour—The stem or branch is white, the smaller branches yellowish-white ; the polyp-stalks reddish ; the polyps red ; the tentacles white with red spicules on the aboral surface.

Locality : Off Ganjam Coast, 28 to 30 fathoms.

Dendronephthya, sp. (?)

This is only a fragment of a colony. It measures 2.5 cm. in height and 1.5 cm. in maximum width.

The stalk is about 2 cm. in length, somewhat leathery in texture, and more or less rigid. Its upper portion is hidden by the reflexed flattened branches, and from the base it gives off a number of slender stolons.

Only the lowest part of the polyparium is left. Of its branches two are flattened and leaf-like, and almost surround the stem, leaving free only two small spaces between their bases. Directly below each open space at a slightly lower level a small branch arises with cylindrical lower part and flattened upper part. Above the open space at one side a small branch with slightly flattened stalk arises. The arrangement of the polyps seems to be in small groups of about six; they are placed on short stalks.

The polyps are low, measuring about 0.36 mm. in height and 0.42 mm. in breadth, and are placed at a right angle to the stalk. The spicules are arranged in eight double rows, in each lateral row there are three to four pairs and in the dorsal rows two to three pairs. In each lateral row one of the uppermost pair projects for a distance of 0.09 mm. beyond the polyp, and has a length of about 0.27 mm.

Cortical spicules: (*a*) In the stem there are spindles either curved or straight, and averaging about 2.2 mm. in length.

(*b*) In the stalk there are spindles which are often branched, Y- and L-shaped forms, covered with prominent rough thorns. In addition there are smaller smooth spindles and irregular star-shaped forms with few spines. The spindles measure up to 1.8 mm. in length by 0.21 mm. in breadth.

Canal-wall spicules: In the stalk there are spindles, three- and four-rayed forms, all being rather smooth and bearing few prominent blunt spines. The spindles measure up to 1.5 mm. in length and 0.15 mm. in breadth. In addition there are a few flat irregular spindle-shaped to star-shaped forms.

Locality: Yé, Burma.

The following species, which have been described by Miss Harrison¹ from the earliest "Investigator" collection, are included for the sake of completeness.

"A. Forms belonging to the *Divaricate cervicornis* group of Kükenthal.

"*Spongodes thomsoni*, Harrison.

"Branches given off from whole or greater part of both sides of stem in one plane; branches subdivided into twigs each bearing bunches of three to ten polyps; polyp-stalks 1-2 mm. long, borne at right angles to stalk. One spicule projects 1 mm. beyond each polyp-head. Spicules of anthocodia in eight double rows arranged 'en chevron,' one large spicule to each point, other smaller spicules irregularly disposed.

¹ Harrison, "Journ. Linn. Soc. Zool.," vol. xxx., March, 1908.

"Colour—Stem and main branches yellowish-white; twigs becoming gradually orange; polyps white.

"*Hab.*: Two specimens from Bay of Bengal.

"**Spongodes elegans**, Harrison.

"Main stem divides into two branches, each of which divides again into two, and these further subdivide into numerous twigs; two lower branches form a flattened collar nearly encircling the stem. Polyps, borne on stalks 1 mm. long, in clusters of four to eight; one large spicule projects about 2 mm. below each polyp. Anthocodia with eight double rows of four to six spicules arranged 'en chevron,' outermost larger and projecting beyond bases of tentacles. Tentacles with double row of colourless spicules.

"Colour—Sterile stem a light brick-red; main branches white, shading gradually from pink to red twigs; polyps red with white tentacles.

"*Hab.*: Bay of Bengal.

"**Spongodes biformata**, Harrison.

"Two lower branches flattened, forming two nearly complete semicircles round stem; above these two lateral branches, and above these again the main stem divides into two branches which further subdivide and bear polyps in bundles of four to eight on stalks of 1-2 mm. Polyp-heads protected by bundle of three to five spicules, two or three of which project slightly. On the lower flattened branches polyps alternately borne on stalks or sessile on the edge of the flattened branch. Branches very distinctly in one plane. Spicules of anthocodia 'en chevron' in eight double rows of four to six spicules each, all the same size and not projecting beyond bases of tentacles.

"Colour—Base nearly white; all other spicules of stem, branches, anthocodia, and tentacles yellow.

"*Hab.*: Bay of Bengal."

"B. Form belonging to the Divaricate *rigida* group of Kükenthal.

"**Spongodes rubescens**, Harrison.

"Whole colony very firm and rigid; main stem divided into numerous short branches which subdivide into smaller branches and twigs bearing polyps in groups of two to eight at about right angles to branch. Lower branches flattened, one partly encircling the stem, others forming flattened plates with polyps all round the edges. One spicule projects about 1 mm. beyond each polyp. Spicules of anthocodia more or less in eight double rows, but chevron

arrangement not very distinct; spicules projecting beyond bases of tentacles. Tentacles with double rows of deep red spicules.

“Colour—Stem and main branches white; secondary branches and twigs yellow; below the bunches of polyps the spicules show a red core, and there is a gradual transition from yellow to red; polyps red.

“*Hab.*: Bay of Bengal.”

Sub-family, Siphonogorginae.

Siphonogorgia variabilis (= *Chironephthya variabilis*, Hickson).

„ *macrospiculata* (= *Chironephthya macrospiculata*, Thomson and Henderson).

„ *mirabilis*, Klunzinger (= *S. pustulosa*, Studer).

„ *macrospina*, Whitelegge.

„ *rotunda*, Harrison.

„ *media*, n. sp.

„ *palmata*, n. sp.

„ *annectens*, n. sp.

„ *asperula*, n. sp.

„ *duriuscula*, n. sp.

Scleronephthya flexilis, n. sp.

Stereacanthia indica, Thomson and Henderson.

„ *armata*, n. sp.

Cactogorgia celosioides, Simpson.

„ *expansa*, Simpson.

„ *alciformis*, Simpson.

Incertæ sedis:—*Dactylonephthya granulata*, n. gen. et sp.

GENUS SIPHONOGORGIA, Kölliker.

Hickson in the “Alcyonaria of the Maldives,” Part I., p. 487, drew attention to the possibility of uniting the two genera *Siphonogorgia* and *Chironephthya*. He pointed out that such characters as (1) the distribution of the polyps and (2) the retractility of the anthocodiae, given by Wright and Studer as diagnostic of *Chironephthya*, are quite untenable. At the same time he drew attention to the anthocodial armature and distinguished between an “en chevron” and a “fan-like” arrangement in the “points”. He says: “It is probable from the literature of the subject that in most of the species of *Siphonogorgia* the arrangement of these spicules is similar to this,” *viz.*, fan-like.

An examination of a large number of specimens has, however, convinced us that this is untenable, as in a single colony both types, with intermediate forms, were found.

The distinction based on the mode of growth, *i.e.*, Nephthyid-like in

Chironephthya and Gorgonid-like in *Siphonogorgia*, is also unworkable, since we have found forms, agreeing in armature and spiculation, exhibiting both types.

The arrangement of the main canals is also a character on which little stress can be laid. Two types may be distinguished in extreme forms, one with thin collapsible walls and large irregular canals, the *Chironephthya* type, and another with small circular canals and thick hard walls, the *Siphonogorgia* type. Linking types exist, however, and apart from these we should not feel justified in separating the two genera on so slender a basis.

We are therefore inclined to merge them, as Kükenthal has proposed, retaining the older name *Siphonogorgia*.

Siphonogorgia variabilis (Hickson) (– *Chironephthya variabilis*, Hickson).

This species, described by Hickson (1903), is represented by several specimens. We submit the following details as a contribution to the study of the variability of this plastic species.

(A) A slightly damaged specimen, 13 cm. in height and 6·5 cm. in breadth consisting of a main stem, broken near the base, 1·8 cm. long and 1·2 cm. in diameter, which immediately divides into two main branches. These again give off secondary branches and in exceptional cases tertiaries occur. The main stem and branches are almost circular and are covered by a network of small spicules. The smaller branches are wrinkled, due in part to the collapse of the walls supporting the canals. On these smaller branches the spicules are large and arranged longitudinally. The polyps are scattered irregularly over the branchlets and in no case could a spiral arrangement be traced. Each is supported within a definite calyx.

The spicules are all transparent, warty, straight or bent spindles.

(a) Large spindles on the branchlets and supporting the verrucæ, 2·6 mm. × 0·3 mm. ; 2·4 mm. × 0·3 mm. ; 2·2 mm. × 0·15 mm.

(b) Polyp spicules—mostly club-shaped and curved—warty to spiny, 0·6 mm. × 0·05 mm. ; 0·6 mm. × 0·04 mm.

The colour of the colony is white to greyish.

Locality: Persian Gulf, 48-49 fathoms.

(B) Two magnificent specimens measuring 11 cm. × 4·5 cm. and 11 cm. × 5·5 cm. The first is a complete colony consisting of a short main stem, 1·5 cm. long and 1·8 cm. broad at the base, which first gives off a few small branches and then bifurcates into two main upright branches. These again give off smaller branches and only on the latter are polyps to be found.

The second specimen is incomplete at the base, which is 1·2 cm. in diameter, and is marked by its profuse branching in all directions, thus forming a compact colony slightly flattened in one plane.

Transparent spicules of the coenenchyma, 2·8 mm. \times 0·3 mm.; 2·55 mm. \times 0·25 mm.; 1·2 mm. \times 0·25 mm.

Purple spicules of the coenenchyma, 2·7 mm. \times 0·25 mm.; 2·5 mm. \times 0·3 mm.

Club-shaped and curved pale yellow spicules of the "crown and points," 0·55 mm. \times 0·04 mm.; 0·5 mm. \times 0·05 mm.; 0·55 mm. \times 0·05 mm.

The colour of the general coenenchyma is pale brown merging into purplish-red in the polyp-bearing branches. The polyps are of a bright yellow colour.

Locality: Table Island (Cocos), Andamans, 15-35 fathoms.

(C) An almost complete specimen 6 cm. high and 3·5 cm. in breadth. The main stem, which is broken, is 1·5 cm. long and 0·7 cm. in diameter. In the lower part small branches are given off, but ultimately it divides into three almost equal branches about the same level. These again bear secondary branches on which are borne the polyps.

Spicules: Of coenenchyma—transparent warty spindles, 1·5 mm. \times 0·25 mm.; 1·8 mm. \times 0·3 mm.

Yellow warty spindles, 2·5 mm. \times 0·4 mm.; 1·8 mm. \times 0·25 mm.; 1·5 mm. \times 0·15 mm.

Of polyp—"crown and points"—pale yellow spiny spindles, 0·6 mm. \times 0·05 mm.; 0·55 mm. \times 0·045 mm.

Tentacles—red spiny spindles, 0·1 mm. \times 0·02 mm.; 0·14 mm. \times 0·015 mm.

Colour—General coenenchyma—yellow; "crown and points"—yellow; tentacles—red.

Locality: Table Island (Cocos), Andamans, 15-35 fathoms.

(D) A single slightly damaged specimen attached to a piece of rock by a basal expansion of 2·1 cm. and measuring 8 cm. in height by 4·5 cm. in breadth. On the main stem, which is 1·5 cm. long and 0·7 cm. in diameter, small branches arise near the base, higher up three almost equal branches are given off and from these arise the secondary branches which bear the polyps.

Spicules: Of coenenchyma—transparent and pinkish warty spindles. These vary from 2·3 mm. \times 0·3 mm. to 0·5 mm. \times 0·04 mm.

Of polyps—transparent and more irregular spiny spindles of the "crown and points," 0·4 mm. \times 0·05 mm.; 0·6 mm. \times 0·04 mm.

Colour—Pinkish tint near the base but grey in the main stem and branches, merging gradually into a dull red near the tips of the secondary branches; polyps—white.

Locality: Andaman Sea, 41 fathoms.

(E) Several small fragments of secondary branches of exquisite colouring.

Spicules:—Of coenenchyma—pale yellow warty spindles, 1·5 mm. \times 0·2 mm. to 0·25 mm. \times 0·02 mm.

Of polyps—red, curved and club-shaped spiny spindles of “crown and points,” $0.7 \text{ mm.} \times 0.05 \text{ mm.}$; $0.5 \text{ mm.} \times 0.035 \text{ mm.}$ Red irregular ragged discs of the tentacles, $0.15 \text{ mm.} \times 0.02 \text{ mm.}$; $0.1 \text{ mm.} \times 0.025 \text{ mm.}$

Colour—general coenenchyma yellow, polyps—bright red.

Locality: Andamans.

(F) A beautiful complete colony 5.5 cm. in height and 2.5 cm. in maximum breadth.

It consists of a main stem with a slightly spreading base from which branches arise at indefinite intervals. Immediately above the base several very small branches come off, but further up larger and more robust offshoots arise at very acute angles. This feature is very marked in the case of one polyp-bearing branch which extends parallel to the main stem throughout its whole course.

A dense covering of large spicules, arranged for the most part longitudinally, extends over the whole surface of the colony.

The colour of the general coenenchyma is a creamy-white, but the bright red anthocodiae are prominent and are scattered over the whole colony. They are retractile within verrucae which are by no means prominent, consisting of a few projecting spicules irregularly arranged. The verrucae measure about $.5 \text{ mm.}$ in diameter. The “crown and points” arrangement is very distinct, the “crown” consisting of six to eight rows of curved spindles, while in each “point” there are two large club-shaped spindles with a few very small ones between.

The polyps are scattered at fairly wide intervals over the branches but appear as if clustered at the tips.

The spicules of the coenenchyma are very large, densely warted, pale yellow spindles, straight and curved, and give the following measurements length by breadth in millimetres: $5 \times .55$; 4.5×0.5 .

Smaller spiny spindles measure about 0.9×0.075 .

In the polyps the spicules are red, curved and club-shaped spindles of the following dimensions in millimetres: 0.35×0.02 ; 0.4×0.03 .

Locality: Andamans, 270-45 fathoms.

(G) A small colony, 8 cm. in height by 5.5 cm. in breadth, with quite irregular branching. The branches are short and thick with the polyps clustered chiefly around the blunt end. General colour—brown. Polyps—dark red. Arakan Coast, 13 fathoms.

(H) Another small colony, 3.5 cm. , 1.5 cm. Main stem 1 cm. in breadth, having but a few lobes. General colour, sulphur-yellow; polyps—red; tentacles—yellow. A note attached to it reads: “Sulphur-yellow stem, deep maroon (?) florets, yellow centre”.

Table Contrasting Colour Varieties of Siphonogorgia variabilis.

Specimen.	COLOUR.			Locality.	Depth.
	General Coenenchyma.	Polyps.	Tentacles.		
A	White to greyish	White	White	Persian Gulf	48-49 fms.
B	Pale brown merging into purplish-red	Bright yellow	Bright yellow	Table Is. (Cocos), Andamans	15-35 fms.
C	Yellow	Yellow	Red	Table Is. (Cocos), Andamans	15-35 fms.
D	White merging into dull red in branches	White	White	Andaman Sea	41 fms.
E	Yellow	Bright red	Bright red	Andamans	
F	Creamy-white	Bright red		Andamans	270-45 fms.
G	Brown	Dark red		Arakan Coast	13 fms.
H	Sulphur-yellow	Red	Yellow		

***Siphonogorgia macrospiculata* (Thomson and Henderson) (= *Chironephthya macrospiculata*, Thomson and Henderson).**

This outstanding species is at once distinguished by the large size of its spicules. It is represented by a single specimen attached to a piece of rock. The basal portion is a stolon-like growth, extending over 2·6 cm. by 1·6 cm., from which there arise two separate stems 7 mm. apart. These curve outwards so as to form a V with convex sides. One of these, which is 2·5 cm. high and 0·9 cm. in diameter at the base, remains simple throughout its entire length; but the other, 2·7 cm. high and 0·9 cm. in diameter, divides into two equal branches about 2 mm. from the basal portion. The outer branch again immediately gives off another lobe-like portion.

The whole colony is markedly stiff and rigid owing to the presence of large white spicules which curve upwards and present a singularly rough surface. The interstices are filled up with smaller white and red spindles.

The colour is a light brown, but the white granular-looking spicules give the whole a streaky appearance.

Polyps occur all over the colony but more closely packed near the tips of the branches. They are borne on very distinct calyces which have a characteristic structure. Three or four large spicules stand out from the general coenenchyma at an acute angle. Between these and the main surface several smaller spicules fill up the gaps, so that there results an almost semicircular platform bounded on the other side by the cortical layer of the stem. Within this the anthocodia can be retracted.

The "points" of the anthocodæ are very well defined, being built up of four large spicules arranged "en chevron". Between each pair of points there occur several smaller spicules. On the tentacles the spicules are arranged in V-like pairs, the apices directed towards the proximal end, but in some cases this arrangement is more irregular or more nearly parallel. The spicules of the tentacles, except for a small part at the proximal and distal ends, are red in colour.

In the coenenchyma the spicules are warty or spiny, straight, curved or S shaped. Most of them, and especially the larger ones, are transparent, but some are reddish. The following are some of the measurements in millimetres :—

(a) Transparent, 8.2×0.85 ; 6.3×0.8 ; 1.5×0.25 .

(b) Tinted, 0.3×0.04 ; 0.2×0.025 ; 0.1×0.02 .

The spicules of the anthocodæ are spiny spindles, straight, curved or club-shaped, and are transparent except those on the middle of the tentacles. The measurements in millimetres are as follows :—

Crown and points, 0.8×0.09 ; 0.55×0.1 .

Red spindles from the tentacles, 0.25×0.03 ; 0.15×0.02 .

Locality : Malabar Coast, 36 fathoms.

Siphonogorgia mirabilis, Klunzinger (= *S. pustulosa*, Studer).

This species is represented by a much broken creamy-white colony, which could not have been less than 13 cm. \times 10 cm.

It is branched in one plane, the branches arising at various angles, some perpendicularly, afterwards taking an upward course, so that the general impression is of a rigid flabellate colony with sinuous branches. The main branches are cylindrical, but the smaller twigs are not so regular in outline and are somewhat flexible.

The spicules on the main stem and branches are arranged transversely, but on the finer twigs they are longer and disposed longitudinally.

The canal system is very clearly seen in the larger branches where there is one large central canal surrounded by three smaller ones, while between these and the circumference there are several still smaller almost inconspicuous canals. The spicules around the central canals have a decided red tinge.

The polyps are disposed over the whole colony, in a slightly spiral manner, at intervals of about 1 to 3 mm. on the main stem, and further apart on the branches except at the tips of the twigs where they occur in clusters.

The calyces are about 1.5 mm. long and 1 mm. in diameter and are built up of spicules so placed that the points are directed inwards and form a protection for the retracted polyp.

Four to six rows of spicules form the "crown" of the anthocodiae. The arrangement of the spicules on the "points" is not constant. The following "arrangements" were observed :—

(a) Two large spicules with one between them—three or four occurring between the several "points".

(b) Five large spicules, two on one side and three on the other, directed inwards.

(c) No definite arrangement.

The spicules of the main stem and branches are mostly spindles pointed or with rounded ends. These are covered with warts, some of which are rounded and smooth, while many are spiny and appear as knobs with a constricted neck. The spindles measure in millimetres 1.2×0.3 ; 1.4×0.4 .

Those of the smaller twigs are of the same type but larger— 2×0.3 mm.

On the anthocodiae they are spiny irregular spindles. The following are some of the measurements in millimetres :—

(a) "Crown and points," 0.4×0.02 ; 0.4×0.025 .

(b) Tentacles, 0.15×0.01 .

Locality : Persian Gulf, 48-49 fathoms.

Another slightly damaged specimen 15 cm. long and 4 cm. broad may be referred to this species. A somewhat spirally twisted or sinuous stem arises from a thickened base. Branches come off mostly from two sides and diverge at various angles. They have no definite arrangement and the distance between them is by no means constant.

Polyps occur scattered over the whole colony separated by intervals of 3 to 7 mm. on the main stem. The colour of the general coenenchyma is red while that of the polyps is yellow. The calyces could in no way be termed prominent but appear as slight warts on the coenenchyma. None appear on the main stem below the origin of the first branch, but on the smaller branches they are fairly close together.

The crowns of the anthocodiae are composed of four to five rows of curved spindles and points. On the tentacles the spicules are arranged in pairs pointing towards the distal end.

The spicules of the coenenchyma are large red warty and spiny spindles and have the following measurements in millimetres :—

(a) Warty, 1.8×0.3 ; 1.6×0.3 .

(b) Spiny, 0.8×0.05 ; 0.85×0.05 .

On the anthocodiae the spicules are of the same shape, but club-shaped forms also occur. They are of a very pale yellow colour and measure as follows :—

(a) Crown and points, 0.4×0.04 ; 0.3×0.045 .

(b) Tentacles, 0.12×0.02 .

We have no hesitation in referring these specimens to the above species,

nor have we any doubt as to the merging of Studer's species into Klunzinger's *S. mirabilis*. Klunzinger's description is exceedingly good, and in addition to this we have examined the British Museum type specimen of *Siphonogorgia pustulosa*.

Locality : Off Table Island (Cocos Group), Andamans, 15-35 fathoms.

To this species we also refer a small specimen in the Wood-Mason collection which may be a colony with the basal portion broken off. It is 50 mm. in height and 20 mm. in breadth. The colour of the colony is almost coral-red, but becomes slightly orange-red towards the apex. The main stem divides into two branches, and each of these again gives rise to a secondary, one however being very rudimentary.

In general structure, architecture and spiculation this specimen closely resembles *S. mirabilis*, to which species we therefore assign it.

Previously recorded from the Red Sea and as Studer's *S. pustulosa* from the New Hebrides.

Siphonogorgia macrospina, Whitelegge. Plate IX., fig. 8.

To this species (as described by Whitelegge in "Memoirs of the Australian Museum (X.), Alcyonaria of Funafuti," Part I., p. 224) we refer several broken fragments. Two pieces which evidently form the basal portion of a tall colony are over 100 mm. in height. Even at the base the diameter is only 9 mm. but it tapers gradually to 3.5 mm. at the top. Another basal portion is 45 mm. in height and has an almost uniform diameter of 3.5 mm. All the fragments are hard but slightly flexible and rather brittle. The length of the spicules—up to 6 mm.—seems to differentiate this species distinctly from all others. Towards the base of the colony these are smaller and arranged irregularly, overlapping one another in all directions; further up, however, they assume a longitudinal direction and are more curved and sinuous.

The branches arise almost at right angles and do not differ much in thickness from the stem at their point of origin.

The polyps occur almost all over the stem and twigs, except near the base, at distances of 2 to 4 mm. apart; a faint hint of a spiral arrangement may be noticed. It is noteworthy that, especially in the smaller twigs, a long spindle is very often curved round the verruca so that the polyp is protected within a small sinus. The verrucae are somewhat rudimentary and resemble in shape the edible nest of the swallow (*Collocalia*); it is more a projecting ledge than a distinct cup. The anthocodia thus appears to arise obliquely from the support. There is a distinct "crown and points" arrangement of the spicules on the anthocodiae. Just above the oesophageal region there is a "crown" or collaret, composed of several rows of curved spindles, and surmounting this eight triangular "points" each consisting of six to eight spindles arranged "en

chevron," the innermost being generally very small. On the aboral surface of the tentacles there is a dense double row of spicules; these are arranged transversely, but slightly "en chevron".

The colour is orange-yellow to brown; the polyps are distinctly of the latter tint.

Locality: Gaspar Strait, E. Coast of Sumatra.

Previously recorded from Funafuti, Whitelegge.

Siphonogorgia rotunda, Harrison.

A portion of what has evidently been a large colony, in the Wood-Mason collection, approaches the description given by Miss Harrison in her preliminary note ("Jour. Linn. Soc.," vol. xxx., 1908), and as it differs from others already described we rank it under the above species for the present and wait for her fuller description. It is pinkish-brown in colour and is 80 mm. in height and 30 mm. in breadth. The verrucæ are very indistinct and the anthocodæ are white. The architecture of the latter agrees with Miss Harrison's description.

Siphonogorgia mediâ, n. sp. Plate III., fig. 12 a, b and c; Plate IX., figs. 7a, 7b.

A single specimen, 5 cm. in height and 7 cm. in diameter at the base, tapering gradually to 5 cm., represents this species. At 1.6 cm. from the disc of attachment a branch arises perpendicularly from the main stem and measures 1.5 cm. in length and 5 cm. in diameter, tapering to 4 cm. The whole colony is stiff and rigid and is supported by a dense felt-work of very large interlocking spicules. The colour is a creamy-white but slightly pinkish near the base.

Polyps occur over the whole stem and branch, but with no definite arrangement. They are separated by distances of about 4 mm. except at the tips where they are much closer. The polyps are large, measuring 2 mm. in length and 1.75 mm. in diameter, *i.e.*, when they are exerted but with the tentacles infolded. They are retractile within fairly prominent calyces, formed by a definite arrangement of large longitudinally disposed spicules.

On the anthocodæ the "crown and points" arrangement of spicules is very marked being visible even to the naked eye, the points projecting well beyond the infolded tentacles. The "point" consists of two very definite club-shaped spicules touching almost throughout their entire length and having a curved spindle as a base to the triangle. Within the triangle the small space contains a single spicule. The crown is composed of about twelve rows of curved spindles which interlock and diminish in size as they pass down the neck.

The spicules of the general cœnenchyma are opaque, white, variously twisted, very large spindles covered with multi-tuberculated warts. They have the following measurements in millimetres: 4.75×0.55 ; 4×0.5 .

Those of the polyp are more transparent, the point spicules being club-shaped, while those of the crown are curved spindles. They measure in millimetres :—

“Point,” 1×0.15 ; 0.9×0.15 .

“Crown,” 0.8×0.1 ; 0.75×0.05 ; 0.5×0.02 .

Tentacles, 0.25×0.02 .

Locality : Andamans, 270-45 fathoms.

Contrast of S. macrospiculata and S. media.

The species *S. macrospiculata*, Thomson and Henderson, and *S. media*, n. sp., are sharply defined from all the others, but they exhibit such decided affinities with one another that it has been thought advisable to draw up a tabular summary emphasising the main points of distinction.

	<i>S. macrospiculata.</i>	<i>S. media.</i>
Habit of colony . . .	Erect and rigid.	Erect and rigid.
Mode of branching . . .	Branches come off at about 45° - 60° .	Branches arise perpendicularly.
Nature of calyx . . .	Very prominent. Anthocodiæ enclosed between cœnenchyma and an almost vertical barrier of immense spicules.	Fairly prominent. Spicules arranged longitudinally at about the same level.
Anthocodiæ—	Very large.	Large.
(a) “crown” . . .	Four rows.	Twelve rows.
(b) “point” . . .	Four large club-shaped spicules with a few small ones between.	Two very large spicules with one forming the base and one enclosed.
Spicules—		
(a) Cœnenchyma . . .	Maximum, 8.2 mm.	Maximum, 4.75 mm.
(b) Tentacles . . .	Average, 0.25 mm.	Average, 0.2 mm.

Siphonogorgia palmata, n. sp.

Belonging to this species there is in the collection a beautiful characteristic colony 60 mm. in height and 45 mm. in maximum breadth. It is expanded in one plane ; the disc of attachment is 30 mm. long and 11 mm. in breadth.

The lower 15 mm. consist of an expanded plate, slightly convoluted ; at the top of this it divides into two main parts, while again as a side offshoot still another small lobe is given off. These secondary stems are themselves much flattened and again give off tertiaries of a similar nature—very thick and lobate.

The whole colony is extremely stiff and rigid and is supported by large thick spindles arranged irregularly in the lower portions but more longitudinally in the tertiaries.

Polyps occur indefinitely over the whole colony except on the lower 15 mm. of the main stem. The verrucæ are ledge-like and only in exceptional cases encircle the polyp. They are extremely substantial and the ends of the large spicules project at the top so as to form an efficient shield to the more delicate anthocodia. The anthocodiæ are proportionately very small but bear a distinc-



Fig. 60. Tip of branch of *Siphonogorgia palmata*, n. sp., $\times 4$.

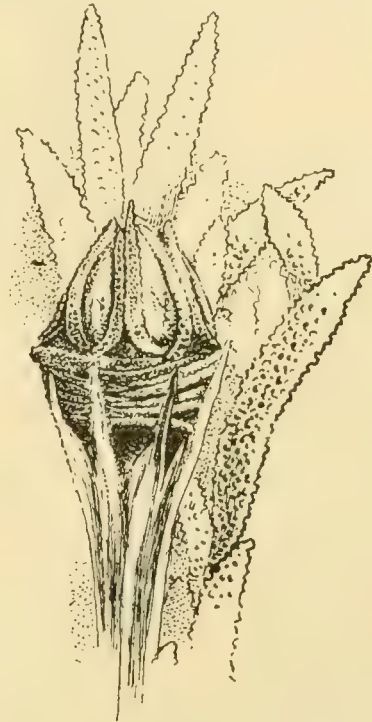


Fig. 61. Polyp of *Siphonogorgia palmata*, n. sp., $\times 25$.

tive opercular armature. There is a very definite "crown" or collar composed of eight to ten rows of curved interlocking spindles which diminish in size towards the stomodæal region; surmounting this are eight well-marked "points," each of which consists essentially of two very large unequal bent spindles touching on their convex sides for the upper half but diverging at the base. Between these there may be one or two small spindles, while between the points one sometimes finds a pair of spicules. Thus there may be an approach to Hickson's "fan-arrangement".

The colour is orange-yellow but the anthocodiæ have a deeper orange tint while others are red.

Locality : Andamans.

Siphonogorgia annectens, n. sp.

This species is represented by a small dull-red compact colony, 4 cm. high and 4 cm. in maximum breadth, composed of a flattened basal expansion 3 cm.

in breadth from which there arise four digitiform processes almost at right angles. These average 2.5 cm. in height and 1 cm. broad, each again bearing a similar offshoot.



Fig. 62. Tip of branch of *Siphonogorgia annectens*, n. sp., $\times 4$.

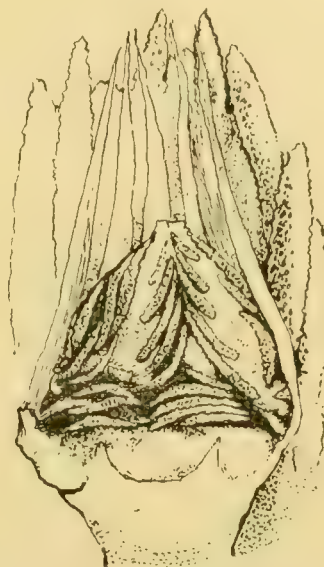


Fig. 63. Polyp of *Siphonogorgia annectens*, n. sp., $\times 25$.

The interior of the stalk is very soft and has very few spicules. The partitions of the walls are thicker than usual, and there is a distinctly gelatinous mesogloea.

The whole surface of the colony bears verrucæ, 2.5 mm. high and 2 mm. broad, built up of long spicules bound together. They stand appressed to the main mass so that the openings are directed upwards. They are separated by short intervals, being distant about 2 mm., and are so disposed that the top of one is on the same level as the base of the next above it, alternating slightly but not regularly.

The anthocodæ are wholly retractile within these verrucæ, and show a distinct "crown and points". The "points" are composed of five to eight spindles arranged somewhat irregularly. The "crown" contains about five rows of curved interlocking spindles all red in colour.

The spicules of the cœenchyma are large, red, transparent, irregularly twisted spindles and have the following measurements in millimetres : 1.5×0.5 ; 1.8×0.2 ; 2×0.3 .

Those of the anthocodæ are club-shaped and curved spindles, red and transparent, with the following measurements in millimetres : 0.8×0.06 ; 0.6×0.05 ; 0.5×0.04 .

This species bears a strong resemblance to *Nidalia macrospina*, Kükenthal.
Locality : Off Puri Orissa Coast, 10 fathoms.

Siphonogorgia asperula, n. sp.

To this new species we refer two colonies which, though differing in certain respects, *e.g.*, the grouping of the verrucæ, and in the details of the spicules, yet present certain well-marked affinities, *e.g.*, the architecture of the anthocodiæ. The essential specific distinctions as well as the differences *inter se* may best be summarised in a table.



Fig. 64. Branch of *Siphonogorgia asperula*, n. sp., $\times 4$.

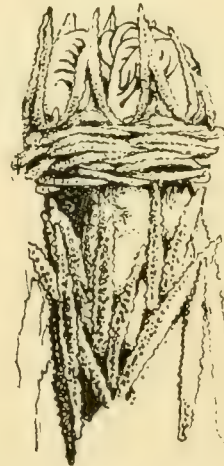


Fig. 65. Polyp of *Siphonogorgia asperula*, n. sp., $\times 25$.

Siphonogorgia asperula, n. sp.

Habit of Colony.	Internal Structure of Stem.	Nature of Verruæ.	General Spiculation.	Architecture of Anthocodia.	Colour.	Locality.
Massive but with numerous short branches; the verruæ are very thickly clustered on the short branches and on the tip of the main stem.	Far from solid, occupied by numerous almost equal canals with extremely thin partition-walls. "Chironephthya-type."	Unsymmetrical cylinders strengthened externally by two "Stütz-bündel"-like sheaves.	Elongated slender, often bent spindles with large warts; the spicules are mainly longitudinal but considerably interlaced and with some irregularity.	"Crown": six rows of large spindles with a few smaller in the oesophageal region. "Points": two large spindles bent at the base with one or two small ones between adjacent points. Tentacles: two transverse rows.	Pale-pink throughout.	Off Cape Comorin, 38 fathoms.
Much branched; verruæ on the upper part of the branches.	Numerous large canals occupying almost the whole of the section; thin partition-walls. "Chironephthya-type."	Slightly projecting, composed of a few large longitudinal spicules.	Large broad spindles, chiefly longitudinal except at the base where they are irregular.	"Crown": three or four rows of large spindles with three rows of smaller spindles on the oesophageal region. "Points": two very strong spindles with one or two small ones between them; occasionally there are also one or two between the "points". Tentacles: two rows arranged on the aboral surface in inverted V's.	Spicules have a slight purplish tint.	Andamans.

Siphonogorgia duriuscula, n. sp.

A small massive colony 23 mm. in height and 6.5 mm. in diameter at the base. There is a short stalk from which three almost equal, lobate branches arise; on these the polyps are borne; the largest is 17 mm. in length and 4 mm. in diameter. There are numerous canals in the stem, so that this species approaches the "Chironephthya-type"; several of these canals are almost equal. The general arrangement of the spicules is altogether longitudinal; the spicules

themselves are larger and rather elliptical ; they are covered with very large, close set, compound warts.

The verrucæ occur all round ; they form projecting cups, more developed



Fig. 66. *Siphonogorgia duriuscula*, n. sp.—Colony ($\times 3$).



Fig. 67. *Siphonogorgia duriuscula*, n. sp.—Polyp ($\times 25$).

externally and all directed upwards ; about eight spicules form the external wall and present an irregular, toothed opening.

The architecture of the anthocodiæ is very distinct ; the “crown” is composed of four to six rows of curved spicules ; each of the “points” consists of two pairs of spicules arranged “en chevron,” while on the aboral surface of the tentacles there are two almost transverse rows.

The colour of the spicules of the general cœenchyma is yellowish to pink ; that of the “crown and points” is dark crimson-red, but the tentacles are white.

Locality : Off Cape Comorin, 38 fathoms.

Miss Harrison¹ has reported the following four species from the Bay of Bengal :—

“*Chironophthya variabilis*, Hickson.

“Fragments of three specimens from the Bay of Bengal.”

“*Chironophthya pendula*, var. *indica* (n. var. = *Siphonogorgia pendula*, Studer).

“Differs from Studer’s specimen in the immense size of the spicules of the partition-walls.

“*Hab.* : Bay of Bengal.”

¹ Harrison, “*Jour. Linn. Soc. Zool.*,” vol. xxx., March, 1908.

"Chironephthya siphonogorgica, n. sp.

"Branches few in number, directed obliquely upwards and not further subdivided. Polyps borne directly on main stem and branches. Each polyp completely retractile within a definite calyx, which can be closed over the retracted polyp. Spicules of stem and branches disposed longitudinally and somewhat loosely packed together. Stem spicules bright coral-red; polyp spicules bright yellow; tentacles colourless.

"*Hab.*: Two specimens from Bay of Bengal."

"Siphonogorgia rotunda, n. sp.

"Stem and branches solid, smooth, rounded; branching not very great. Polyps borne all round stem, main and sub-branches; lower part of stem barren. Polyps nearly completely retractile, borne at right angles to stem and branches. In the polyp there are about five spicules in each point directed vertically upwards, below these about eight spicules arranged "en chevron," and below these a crown of about six transverse rows.

"Colour—Stem and branches flesh-coloured; polyps white.

"*Hab.*: Bay of Bengal."

GENUS *SCLERONEPHTHYA*, Wright and Studer.

***Scleronephthya flexilis*, n. sp.**

There are in the collection several small colonies of a pale brown colour and also one dark brown or almost black, which we refer to a new species of *Scleronephthya*. They are consecutively 45 mm., 40 mm. and 70 mm. in height. All are expanded more or less in one plane. The largest is 45 mm. in breadth and about 20 mm. in thickness. The main stem gives origin to a few large lobes, but in addition to this there arise a large number of small polyp-bearing lobes both on the main stem and on the primary lobes. The whole colony is much corrugated, but this may be due in part at least to "rigor mortis".

Polyps occur in clusters or singly over the main stem and lobes, but in several places a bare strip occurs. The canal system agrees with the description given by Wright and Studer for the genus, and there is a hint of a central axis—at least a union of certain of the central canal walls with a consequent reduction or *abolition* of the cavities. The canals are somewhat radially arranged and are polygonal in shape (see Wright and Studer, "'Challenger' Report,"



Fig. 68. *Scleronephthya flexilis*, n. sp.

vol. xxxi.), but this shape may again be a result of contraction. We feel that little stress should be laid on such points.

The polyps are cylindrical and are about 2 mm. to 3.5 mm. in length and 1.5 mm. in diameter. The spicules are arranged in eight indefinite groups which in some places form distinct ridges. They are disposed so that the groups point slightly upwards "en chevron," but towards the top of the polyp they often become almost horizontal, though no trace of a collaret as in *Scleronephthya pustulosa* (Wright and Studer) can be said to exist. Above this region the spicules are distinctly "en chevron" and form eight triangular figures, each composed of three to five spicules. These close over the retracted tentacles.

The tentacles also bear small spicules on their aboral surface.

Locality: Gaspar Strait, E. Coast of Sumatra.

GENUS STEREACANTHIA, Thomson and Henderson.

Stereacanthia indica, Thomson and Henderson.

We have referred the genus *Stereacanthia* to the sub-family Siphonogorginae on account of the internal structure of the stalk. Bourne in his classification of the Alcyonaria (in Lankester's "Treatise of Zoology," Part II., Coelenterata) defines the Siphonogorginae as having "Canal walls densely filled with spicules". In *Stereacanthia indica*, Thomson and Henderson, not only are the canal walls packed with spicules, but the latter are extremely large and give great rigidity to the colony; some of them attain a length of 7 mm.

There can be little doubt that the Siphonogorgids are closely connected to the Nephthyids, as Kükenthal points out, through types like *Stereonephthya*, and, in addition, there are external resemblances between species of *Stereacanthia* and some species of *Eunephthya*, notably, *E. spiculosa*, Kükenthal.

But species with the canal walls of the stalk *thickly* filled with *large* spicules, which give great rigidity to the colony, cannot be referred to a genus whose diagnosis includes the character "Canal walls not thickly filled with spicules". A cross section of the stalk of a typical Eunephthyid, *e.g.*, *Eunephthya rosea*, is entirely different in appearance from that of *Stereacanthia*. The armature of the polyps is also very much heavier and more like the "crown and points" arrangement of the Siphonogorgid type.

It is interesting to note the occurrence in this collection of a young specimen of this species described in the "Report on the Deep-sea Forms". Two main stems, 3.2 cm. and 3 cm. in length, with a maximum breadth of 1 and 1.5 cm. respectively, arise from a spreading base. Both are flattened slightly in one plane. In one of them a considerable portion is devoid of polyps, so forming a kind of stalk, above which the polyparium extends with no great difference in diameter. Polyps occur on the other almost to the very base.

There is no definite branching, but lobed processes occur in both, and on these polyps are borne, many also occurring on the general stem.

The general colour of the colony is a yellowish brown and presents a wrinkled appearance due in part to white bent spicules placed in all directions.

The main stem is composed of about twelve longitudinal canals which connect by solenia with the several polyps. The partition walls of these canals, which are densely packed with spicules, give rigidity to the colony but shrivel considerably in spirit. The grouping of the polyps as well as the structure of the anthocodæ are identical with those described in the previous report. But the polyps with their stalks measure about 5 mm.

The spicules are also of the same types but the measurements differ in a marked degree. In the coenenchyma they consist of straight and curved spindles densely covered with papillose warts. The following are some of the measurements in millimetres : 1.8×0.2 ; 2×0.6 ; 0.6×0.3 .

Those of the polyps and polyp stalks are smaller and not so warty. In millimetres they measure 0.6×0.05 ; 0.5×0.05 ; 0.4×0.05 .

The differences between this specimen and the type, *e.g.*, as regards the distinction between stalk portion and branched polyparium, the size of the polyps, the size of the spicules, etc., might at first sight suggest the establishment of a new species, but an examination of the two specimens shows that this procedure would be unjustifiable. We see the need for a comparison of young and older forms, and also that importance should be attached to polyp-structure and not to mere dimensional distinctions.

Locality : Andamans Sea, 270-45 fathoms. Marine Survey.

There are also three small colonies. The largest of these is 28 cm. in height and 25 cm. in breadth with a basal trunk 11 mm. in diameter ; it is considerably flattened in one plane. The second is 20 cm. high and 20 cm. broad and is attached to a piece of coral. In a third, which consists of an expanded basal disc whence arise two almost equal main lobes, the polyps are continued nearly to the base so that the stalk portion is hardly perceptible.

Stereacanthia armata, n. sp.

We refer to this species three specimens which are respectively 65 mm., 40 mm. and 40 mm. in height.

The largest consists of an elongated stalk-portion 11 mm. in diameter from which two large branches about 7 mm. in diameter arise about the same level. These again bear secondary lobes. The stalk of each of the other colonies is very much flattened and in one case is 17 mm. in breadth and 3 mm. in thickness. After a distance of 30 mm. from the base it divides into three almost equal lobes which give it a bush-like appearance.

The whole colony is very rigid, but in spite of this there has evidently been a collapse of the body walls consequent on death. The armature both in the general colony and on the calyces is very dense. In the main stem the canal



Fig. 69. *Stereacanthia armata*, n. sp.
—Terminal portion of twig, $\times 2$.

walls are packed with large spindles longitudinally disposed. On the outer surface the longitudinal arrangement of the interlocking spindles is very evident to the naked eye, even forming in some places distinct ridges.

The polyps arise either singly or in groups of two to ten, both on the primary branches and on the secondary lobes, but are more clustered on the latter. Above the origin of the primary branches, a few scattered polyps occur on the main stem. The polyps are borne on distinct stalks which are supported by very large spicules standing out in relief from the general cœnenchyma. These stalks sometimes attain a length of 2.5 mm. and occasionally one or two of the spicules project beyond the origin of the polyp so as to suggest the appearance of a “Stütz-

bündel”. The spicules of the stalk are very irregularly arranged and curve to the contour of the lobes. The polyps arise at an obtuse angle to the stalk and are supported by eight indefinite groups of spicules, so arranged as to give a slight indication of eight triangles. There is a double row of spicules on the aboral surface of the tentacles and these form a pseudo-operculum over the retracted polyp.

The colour is dull brown but the stem is distinctly paler ; the small colonies are yellowish-brown.

This species comes near *Stereacanthia indica*, Thomson and Henderson, but is easily distinguished from it by the denseness of the armature and by the large size of the spicules.

The following are some of the measurements in millimetres :—

(a) Stem : large warty spindles, 5×0.68 ; 1.6×0.3 .

(b) Twig : large warty spindles, 2×0.45 ; 1.3×0.3 .

Spiny spindles—more slender, 1.2×0.12 ; 1.8×0.11 .

Locality : Andamans.

GENUS CACTOGORGIA,¹ Simpson. Plate VII., figs. 1-9.

Systematic Position.

This new type belongs to the family Nephthyidæ, and the exceptionally dense spiculation of the canal walls indicates its position in the sub-family Siphonogorginæ (Wright and Studer, "Challenger" Reports, Zoology," vol. xxxi., p. 189). In certain respects it shows affinities with the *Chironephthya-Siphonogorgia* type, but the following differences may be noted :—

- (a) The colony is much more densely spiculose, firm and rigid.
- (b) There is a marked distinction into trunk and polyp-bearing portion.
- (c) There is no definite branching, but the polyps are borne mainly on the margin of flattened lobes.

Generic Diagnosis.

The colony is upright with a basal attachment, and resembles a Cactus in its mode of growth; it consists of (1) a basal trunk, very rigid and densely spiculose, in which several small cylindrical canals are imbedded; and (2) an upper polyp-bearing portion, which in some cases bears expanded lobes. There is generally a flattening of the polyp-bearing part and lobes, and the polyps are borne in several rows, for the most part along the margin. The anthocodæ are completely retractile within more or less prominent verrucæ composed of large spicules arranged longitudinally; they are comparatively large and bear a dense armature with a "crown and points" arrangement. The tentacles are not retractile, but are simply infolded and overlap the oral region; they are covered on the aboral surface with numerous scale-like sclerites. The spicules vary in type in the different parts; those of the stem and trunk are thick spindles covered with multi-tuberculate warts; those of the anthocodæ ("crown and points") are straight or curved spiny spindles or clubs; those on the aboral surface of the tentacles are small, flat and scale-like.

The specimens differ so much from one another that they seem to require the definition of three new species, for which the following names are proposed: *Cactogorgia celosioides*, from its resemblance to *Celosia*; *C. expansa*, from its flattened appearance; *C. alciformis*, from its antler-like mode of growth.

Specific Diagnoses.

C. celosioides, Simpson.

The trunk and polyparium are much flattened, of a light brown colour, stiff and rigid, with a translucent sheen. The cœnenchyma is densely spiculose,

¹An account of this new genus and of its species was published separately. See J. J. Simpson, "On a new Siphonogorgid Genus Cactogorgia; with descriptions of three new species". "Trans. Roy. Soc.," Edinburgh, vol. xlv. (1907), pp. 829-36, 1 pl.

with the spicules arranged longitudinally. The polyps are borne in several rows along the margin; the verrucae are cylindrical and distinct; the anthocodiae have a dense armature—a “crown,” consisting of seven to ten rows of curved spindles, and “points,” each composed of a single pair of spindles with occasionally one or two smaller ones between; the tentacles bear numerous small scales arranged “en chevron” on the aboral surface.

The spicules of (*a*) the trunk and polyparium are transparent spindles with numerous multi-tuberculate warts.

Those of (*b*) the anthocodiae are spiny spindles, straight or curved, and clubs.

Those of (*c*) the tentacles are scales.

The following are typical measurements of length and breadth in millimetres :—

(*a*) 2.2×0.55 ; 0.75×0.3

(*b*) 0.95×0.18 ; 0.85×0.1 .

(*c*) 0.07×0.035 .

C. *expansa*, Simpson.

The trunk is cylindrical, the polyparium flattened; both are stiff and rigid, with a densely spiculate coenenchyma, very opaque in appearance. The spicules of the coenenchyma lie in all directions. The polyps arise from the margin of the colony; the verrucae are not very conspicuous; the anthocodiae are densely covered with spicules having a “crown and points” arrangement; the crown consists of about eight rows; the points consist of six to eight pairs “en chevron,” and increasing in size towards the apex. There are numerous small scale-like spicules on the aboral surface of the tentacles.

The spicules are opaque and yellowish :—

Those of (*a*) the trunk and polyparium are multi-tuberculate spindles.

Those of (*b*) the anthocodiae are spiny spindles or clubs.

Those on (*c*) the tentacles are pale yellow transparent scales.

The following are average measurements of spicules length by breadth in millimetres :—

(*a*) 1.5×0.3 ; 1.1×0.2 .

(*b*) 0.8×0.1 .

(*c*) 0.04×0.015 .

C. *alciformis*, Simpson.

The trunk and polyparium are sinuous, much contorted, antler-like, stiff, rigid and translucent; the coenenchyma is densely spiculate, and the spicules are disposed in all directions and interlock. The polyps occur on the margins

of small lobes ; the verrucae are well developed and cylindrical ; the anthocodiae are large, and bear a distinct "crown and points" armature visible to the naked eye ; the "crown" consists of ten to fourteen rows of curved spindles ; the "points" are composed of ten to fifteen spicules slightly "en chevron". The spicules are transparent :—

Those of (a) the trunk and polyparium are warty spindles.

Those of (b) the anthocodiae are spiny spindles and clubs.

Those of (c) the tentacles are scale-like sclerites.

The following are average measurements length by breadth in millimetres :—

(a) 1.6×0.45 ; 0.6×0.15 .

(b) 1.2×0.1 ; 0.5×0.05 .

(c) 0.12×0.02 ; 0.04×0.02 .

Distribution.

All the specimens are from the Indian Ocean, and seem to be of a semi-littoral nature. *C. celosioides* is recorded from the Andamans (depth uncertain) ; *C. expansa* was dredged off Cape Comorin in 38 fathoms ; while *C. alciformis* occurs both at the Andamans and off the Arakan coast ; at the latter place it was found in 13 fathoms.

More Detailed Description.

Owing to the denseness of the spiculation and the consequent damage in decalcification, it was impossible to investigate the histology of these specimens ; but the following more detailed descriptions may give some basis and justification for ranking them under a new and distinct genus.

Cactogorgia celosioides, Simpson. Plate VII., figs. 1-3.

This species is represented by two small specimens of a light brown colour. They present a characteristic appearance which suggests in many respects the coxcomb-flower (*Celosia*). Both specimens are attached by a slightly expanded disc to pieces of detached rock. The first has a cylindrical stalk 16 mm. in length and 6 mm. in diameter, but expanded at the disc of attachment to 10 mm. ; this is surmounted by an upper polyp-bearing portion flattened in one plane and almost semicircular in outline ; it is 20 mm. in length and 19 mm. in breadth just above its insertion on the stalk. The second specimen (fig. 1) has a more irregular contour. The stalk or trunk is also flattened in the plane of expansion of the polyparium ; it is 17 mm. in length and 11 mm. in breadth, and supports a polyp-bearing portion 19 mm. in height and 16 mm. in breadth. From the base of the stalk an offshoot or lobe, 8 mm. in height and 9 mm. in

breadth, is separated by a constriction, and this part also bears polyps almost over the entire hemispherical head.

Both the colonies are stiff and rigid, owing to the dense network of large warty spindles, which are quite visible to the naked eye. These are arranged for the most part longitudinally, and their transparency gives the whole a translucent sheen. Traces of the canals passing to the polyps can be observed on the flat sides.

The stem is traversed by several (about twelve) narrow coenenchymal longitudinal canals, which are almost equally distributed from the centre to the circumference; these are supported by very thick walls densely packed with large tuberculate spindles. The canals pass upwards and branch, so that each polyp is connected with the main portion by means of solenia.

The polyps are situated on the edge of the flattened disc (like the flowers in *Celosia*) in four to six indefinite rows. Each is supported by a hollow cylindrical calycine portion 1.5 mm. in diameter, strengthened by large longitudinally arranged spindles, the points of which project and form a protection for the completely retractile anthocodia. An aberrant polyp arises near the middle of the flat disc; a slight ridge marks the position of the canal from which it takes its origin, and it is possible that this might have been the origin of a lobe similar to that at the base of the colony.

The anthocodiae (fig. 2) are about 1 mm. apart, and when exerted, but with the tentacles infolded, have a height of about 2.75 mm. and a diameter of 1.5 mm. The "crown and points" arrangement described by Professor Hickson for *Chironephthya* is a very prominent feature. The "crown" consists of seven to ten rows of curved spicules placed circumferentially and loosely interlocking. Surmounting this there are eight triangular points, each consisting essentially of two large, slightly curved spindles enclosing an acute angle and touching on their convex sides. Between these, however, there are occasionally one or two smaller spindles disposed more horizontally. When at rest the tentacles are simply infolded and overlap one another; when expanded they have a length of about 1 mm.; their aboral surface is covered with small scale-like spicules disposed "en chevron," but enclosing a very obtuse angle.

Ova, 0.3 mm. in diameter, are very abundant on the mesenterial filaments, but, in spite of their large size, they showed, even when stained, no trace of segmentation.

The spicules are of three kinds, which correspond to the various positions in the colony. The following are some of the measurements of length by breadth in millimetres:—

(A) Trunk and expanded disc portion—transparent spindles densely covered with compound warts (fig. 3a):—

(a) Spindles markedly tapering, 2.2×0.55 ; 2×0.5 ; 1.8×0.4 .

(b) Half-spindles or clubs, 1.05×0.25 ; 0.8×0.3 ; 0.75×0.3 .

(B) Anthocodiae—pale yellow spiny spindles and scales :—

(a) “Crown”—warty curved spindles (fig. 3b), 0.95×0.18 ; 0.85×0.14 .

(b) “Points”—warty spindles straight, curved, or club-shaped (fig. 3b), 0.95×0.1 ; 0.9×0.15 ; 0.85×0.1 .

(c) Tentacles—scale-like, with irregular edges; many are constricted near the middle (fig. 3c), 0.08×0.02 ; 0.07×0.035 ; 0.06×0.02 .

Locality : Andamans.

Cactogorgia expansa, Simpson. Plate VII., figs. 7-9.

Of this species there is but a single specimen, of a pale chocolate colour; it is 35 mm. in height and 30 mm. in maximum breadth. It has a somewhat cylindrical trunk surmounted by two fan-shaped polyp-bearing lobes, which give it a reniform appearance (fig. 7). The trunk or stalk is 19 mm. in height and 7 mm. in diameter; the lobes are respectively (1) 16 mm. in breadth, 11 mm. in height, with a width of 11 mm. at the constriction; and (2) 18 mm. in breadth, 14 mm. in height, with a width of 13 mm. at the constriction. One of the lobes, owing to a downward growth, has become slightly convoluted. This species resembles *C. celosioides* in general character, but the general tone is more opaque.

The polyps, as in the first species, occur mainly on the periphery, but this feature is not so marked; several arise on the flattened portions from points in close proximity to the circumference. The stalk is quite destitute of polyps.

Several canals penetrate the stalk; these have very thin walls, but maintain their cylindrical form by reason of the rigidity of the coenenchyma. They branch in the polyp-bearing part, and separate canals may be traced to the individual polyps.

The coenenchyma is densely spiculose. The spicules on the surface are opaque and appear white; they are arranged in a very irregular manner, so that they present a peculiar and characteristic appearance quite distinct from that in *C. celosioides*.

The verrucae are not very conspicuous; they are supported by spicules arranged for the most part longitudinally, but often quite irregularly. The anthocodiae (fig. 8) are about 1.5 mm. in length and 1 mm. in breadth when partially extruded. They bear a distinct “crown and points” arrangement. The “crown” consists of about eight rows of curved spicules interlocking more closely in the upper portion of the stomodaeal region. Surmounting this are eight points composed of six to eight pairs of slightly curved or club-shaped spindles arranged “en chevron”; these increase in size towards the base of the tentacles. On the aboral surface of the tentacles there are numerous small scale-like spicules arranged longitudinally.

The spicules are predominantly spindles.

The following are some of the measurements of their length and breadth in millimetres :—

(A) Stalk—opaque, yellowish, multi-tuberculated spindles, straight and curved, 1.5×0.3 ; 1.4×0.25 ; 1.1×0.2 (fig. 9a).

(B) Anthocodiae—

(a) “Crown and points”—slightly opaque or translucent tuberculated spindles and clubs, 0.8×0.1 ; 0.75×0.08 ; 0.7×0.075 (fig. 9b).

(b) Tentacles—pale yellow, transparent scales, 0.08×0.02 ; 0.06×0.02 ; 0.04×0.015 (fig. 9c).

Locality : Off Cape Comorin, 38 fathoms.

Cactogorgia alciformis, Simpson. Plate VII., figs. 4-6.

This species is represented by a very rigid colony of an orange-brown colour, 45 mm. in height, 40 mm. in breadth and about 10 mm. in thickness (fig. 4). It has a short basal trunk from which three large lobes arise approximately in one plane. These lobes have the characteristic appearance of the previous two species ; they are markedly flattened and bear the polyps mainly on the margin, but by a torsion in the plane of flattening the latter appear as if clustered terminally. In addition to the three large lobes there are also three smaller groups of polyps.

The whole colony is very stiff and rigid, and the central canal system is almost obscured by the densely packed spinose spindles. The surface, when viewed with a lens, is bright and glistening, and shows innumerable short, thick warty spindles interlocking in all directions.

The polyps occur chiefly on the margin ; they are supported by truncated conical verrucae about 2.5 mm. in height and 2 mm. in diameter at the top. The verrucae are directed towards the upper portion of the colony, and are longer on the outer margin ; they are built up mainly of longitudinally arranged spicules.

The anthocodiae (fig. 5) are completely retractile ; when fully expanded they are 4.5 mm. in length and 2 mm. in diameter. The “crown and points” arrangement of the spicules is not so definite as in the other species. On the stomodæal region the spicules are disposed circumferentially in ten to fourteen interlocking rows. In the upper portion, however, they gradually pass into an “en chevron” arrangement, so that eventually they form eight triangular groups, each consisting of ten to fifteen spindles with no very regular disposition. The diameter of the upper portion is slightly greater than that of the lower.

The tentacles, which are infolded over the oral opening, are 2 mm. in length and 0.75 mm. in breadth. On the aboral surface there is a distinct

spiculation pattern. The triangular part corresponding to the main axis is closely covered with scale-like spicules arranged in pairs forming a V : these become smaller towards the tip, but the same arrangement is distinguishable throughout. The same pattern is continued into the pinnules.

The spicules of the trunk are short, thick spindles densely covered with rough warts. Those of the anthocodæ are longer and narrower; they are thickly beset with spines or small warts. On the tentacles the spicules have an almost scale-like appearance, with slightly irregular edges; some are constricted at the middle.

The following are some of the measurements of length and breadth in millimetres :—

(A) Stalk and trunk, 1.6×0.45 ; 1.2×0.4 ; 1×0.3 ; 0.6×0.15 (fig. 6a).

(B) Anthocodæ, 1.2×0.1 ; 1.1×0.1 ; 0.8×0.075 ; 0.5×0.05 (fig. 6b).

(C) Tentacles—

(a) Scale-like, 0.12×0.02 ; 0.06×0.02 ; 0.05×0.02 (fig. 6c).

(b) Scale-like, with constriction, 0.08×0.03 ; 0.04×0.02 (fig. 6c).

Locality : Andamans.

Another colony, 60 mm. in height and 18 mm. in maximum breadth, consists of a main stem, elliptical in section, with a maximum axis of 9 mm. and a minimum of 6.5 mm., surmounted by an irregular polyp-bearing portion. After a distance of 18 mm. the latter bends at an obtuse angle; after another 11 mm. it again resumes a direction almost parallel to the original course; and yet another flexion causes the whole colony to assume the form of a much-expanded W. At each bend a small lobe arises. The lowest is 14 mm. in length and 5 mm. in breadth at its origin; it is expanded laterally, and has a breadth of 9 mm. at the top. The second is 12 mm. in length and 11 mm. in maximum breadth; at its origin there is a twisting of the axis, and a small polyp-bearing excrescence arises on the opposite side. The fourth is 6 mm. in height, 8 mm. in breadth and 4.5 mm. in thickness. Slightly below the level of the highest lobe the main axis becomes markedly flattened, and attains a breadth of 11 mm. and a thickness of 6 mm.

The cœnenchyma is very hard and densely spiculose; the surface is arenaceous in appearance, but on examination with a lens the distinct spicules may be seen irregularly arranged, and producing a translucent, shiny surface.

On the lobes and also on the main stem the polyps are disposed along the edge. The anthocodæ are about 3 mm. in length and 2 mm. in diameter; the spiculation is distinctly visible to the naked eye, and the white aboral surface of the tentacles is a marked feature.

Locality : Arakan Coast, 13 fathoms.

COMPARATIVE TABLE OF SPECIES OF CACTOGORGIA.

Species.	Nature of Stem and Stock.	Nature and Origin of Lobes.	Arrangement of Spicules of Polyparium.	Verrucae.	Anthocodiae.	Spicules.	Locality.
<i>C. celosioides</i> .	Much flattened; stiff and rigid with a translucent; colour, light brown.	Also flattened and bear polyps; origin indefinite.	Longitudinal.	Distinct; supported by longitudinally arranged spicules with apices projecting around the edge; occur along the margin of the colony.	Definite "crown and points" arrangement; crown consists of 7-10 rows of curved spindles; points each of one pair with occasionally one or two smaller ones between; tentacles bear numerous scales "en chevron" on the aboral surface.	(A) Stem and stock—transparent spindles with multi-tuberculate warts, 2-2 mm. \times 0.55 mm. to 0.75 mm. \times 0.3 mm. (B) Anthocodiae—spindles or clubs—0.95 mm. \times 0.18 mm., 0.85 mm. \times 0.1 mm. (C) Tentacles—scales 0.07 mm. \times 0.035 mm.	Andamans.
<i>C. expansa</i> .	Cylindrical stem with fan-shaped polyp-bearing lobes; densely spiculate and very rigid; very opaque in appearance.	As in <i>C. celosioides</i> .	Indefinite; interlocking in all directions.	Not very conspicuous; no definite arrangement of spicules; mainly on the margin of the lobes.	Definite "crown and points" arrangement; crown consists of about 8 rows of curved spindles; points made up of 6-8 pairs arranged "en chevron," and increasing in size from the base upwards.	Opaque, yellowish. (A) Stem and stock—multi-tuberculate spindles, 1.5 mm. \times 0.3 mm., 1.1 \times 0.2 mm. (B) Anthocodiae—spindles and clubs, 0.8 mm. \times 0.1 mm. (C) Tentacles—pale yellow transparent scales, 0.04 mm. \times 0.015 mm.	Off Cape Comorin, 38 fathoms.
<i>C. alciiformis</i> .	Much constricted; sinuous nature; antler-like; stiff and rigid; translucent.	Considerably flattened; arising mainly at the bends in the stock.	Irregular; interlock in all directions.	Fairly large; spicules disposed mostly longitudinally; occur principally on the margin of the flattened lobes.	Very large; spicular armature visible to the naked eye; "crown and points" arrangement not so definite; crown consists of 10-14 rows of curved spindles; in each triangular point there are 10-15 spindles, with no very regular disposition, but slightly "en chevron."	Transparent. (A) Stem and stock—rough warty spindles, 1.6 mm. \times 0.45 mm. to 0.6 mm. \times 0.15 mm. (B) Anthocodiae—spiny or warty spindles, 1.2 mm. \times 0.1 mm., 0.5 mm. \times 0.05 mm. (C) Tentacles—scale-like, 0.12 mm. \times 0.02 mm. to 0.04 mm. \times 0.02 mm.	Andamans; Arakan Coast, 13 fathoms.

GENUS DACTYLONEPHTHYA, nov.

This new genus is suggested for a small puzzling colony which seems to us to form an intermediate type linking the Spongodinae and Siphonogorginae and Alcyoniidae. Very few characters of true taxonomic importance have so far been assigned to the Siphonogorginae, but, on such grounds as (1) the presence of distinct verrucae and (2) the architectural development of the anthocodial armature, which are so characteristic of the Siphonogorgids, we have been com-

pelled to exclude this new form from that family. The large massive spindles suggest *Sclerophytum*, but there are distinct polyp-calyces.

Among Nephthyids, the possibility of its being allied to *Capnella* suggested itself, but the difference of internal spiculation is against close relationship. In *Capnella* the canal walls are thick and densely packed with relatively *small* spicules which are visible only when viewed with a lens. In *Dactylonephthya* the canal walls are thin and in a cross section are barely visible; at the same time they contain *very large* spindle-shaped spicules which are not *extremely* numerous. To no other genus in the family Nephthyidæ does it show any marked resemblance.

Generic diagnosis.

The colony consists of a short stalk from which branches arise almost vertically, dividing into digitiform lobes on which the polyps are borne. The whole colony is hard and rigid, the interior being packed with *large thick* spindles; these occur on the thin walls of the longitudinal canals; they are most abundant in the stalk, diminishing both in number and size in the lobes. The surface of the colony is smooth to the naked eye, but with a low power presents a glistening arenaceous appearance and a minute tessellated structure. This is due to the heads of abundant small club-shaped spicules.

There are no distinct verrucæ, but a calyx-like portion stands out from the general surface as a low dome; the tentacles are simply infolded and this gives the appearance of an octoradiate structure on the top of the dome.

The spicules of the stalk and central portion of the lobes are long warty spindles; those of the surface of the cœnenchyma are (1) club-shaped, (2) clubs with a hint of foliation, and (3) a few spindles; all these are *much* smaller than the spindles from the interior.

There are few or no spicules in the tentacles.

Dactylonephthya granulata, n. sp.

The colony is 30 mm. in height and 25 mm. in maximum breadth; the basis of attachment is broken off. It consists of a stalk, 10 mm. in length and 8 mm. in diameter, which divides into three nearly equal lobes arranged almost in a whorl. These again bear secondary lobes or digitiform processes in an irregular manner. The diameter of a primary lobe is 6 mm.; that of a secondary lobe is about 2·5 mm.

The polyps are closely apposed on the lobes, twenty or thirty being a common number. There are no distinct verrucæ and anthocodiæ; the tentacles are simply infolded within a small dome-like calyx. The calyx shows an octoradiate structure, and is about 1 mm. in diameter and 0·75 mm. in height.

The appearance of the colony to the naked eye is smooth, but with a low power a markedly glistening arenaceous surface is seen.



Fig. 70. *Dactylonephthya granulata*.—General view of the tip of a lobe of the colony, showing the regular calyces; enlarged about four times.

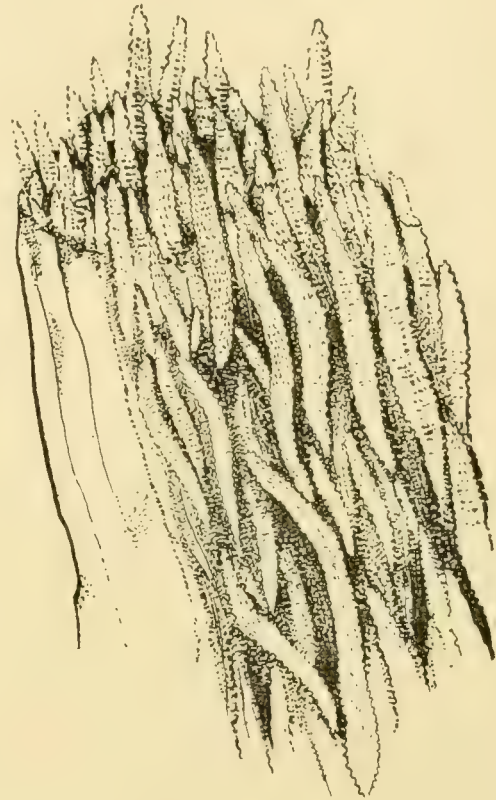


Fig. 71. *Dactylonephthya granulata*.—Portion of stem to show how it is densely filled with large spindles.



Fig. 72. Spicules of *Dactylonephthya granulata*.

The whole colony is hard; the canal walls of the main stem and lobes contain numerous large warty spindles. In addition to these, however, there is an outer layer of *small* clubs, the pointed ends of which are directed inwards; these give the characteristic scale-like appearance; some of these are slightly foliate while others approach the spindle-type. There are few or no spicules in the tentacles.

The following are typical measurements of the spicules in millimetres:—

(a) Large spindles from the interior, 1.02×0.12 ; 1.3×0.15 ; 1.3×0.24 .

(b) Clubs from the external layer, 0.17×0.07 ; 0.19×0.07 .

(c) Spindles from the external layer, 0.17×0.03 .

The colour is pale chocolate-brown.

Locality: Gaspar Straits, East Coast of Sumatra.

ORDER III. PSEUDAXONIA, G. von Koch.

Family *BRIAREIDÆ*.

Sub-family Briareinæ.

GENUS SOLENOCAULON, Gray.

1862. GRAY, J. E. Description of two new Genera of Zoophytes (Solenocaulon and Bello-nella). Proc. Zool. Soc. pp. 34-37, 2 figs., I.; also Ann. Nat. Hist. x. Ser. 3, 1862, pp. 147, 148., II.
1867. GENTH, C. Ueber Solenogorgia tubulosa. Zeitschr. wiss. Zool. xvii. pp. 429-41, 3 pls., III.
1879. STUDER, TH. Uebersicht der Alcyonaria, welche auf der Reise S.M.S. "Gazelle" um die Erde gesammelt wurden. Monatsber. preuss. Akad. Wiss. Berlin, pp. 632-84, 1 pl., IV.
1887. STUDER, TH. Versuch eines Systems der Alcyonaria. Arch. Naturges. liii. pp. 1-74, 1 pl., V.
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1897. GERMANOS, N. K. Gorgonaceen von Ternate. Abh. Senckenberg. Nat. Ges. xxiii. pp. 145-87, 4 pls., VII.
1903. HICKSON, S. J. The Alcyonaria of the Maldives, part I., VIII.
1904. JANOWER, M. Die Gattung Solenocaulon. Revue Suisse Zool. xii. pp. 495-538, 2 pls. IX.
1908. HARRISON, RUTH. Journ. Linn. Soc. (Zool.) xxx. pp. 185-90, X.
- See also DELAGE AND HEROUARD (1901), XI.
- GRAY. Ann. Nat. Hist. v. Ser. 4 (1870), pp. 405-8, XII.
- HICKSON. The classification of the Alcyonaria. Third Internat. Zool. Congress, Leyden (1896), pp. 352-56, XIII.
- RIDLEY. Report on collections during voyage of H.M.S. "Alert" (1881-82), pp. 353-56, XIV.

In 1896 Germanos (Gorgonaceen von Ternate) investigated this genus and ranked the six known species under two sub-genera, *viz.*, *Sclerosolenocaulon* and *Malucosolenocaulon*. He distinguished the two groups chiefly by the presence or absence of a stalk. Hickson in the "Alcyonaria of the Maldives," Part I., 1902, pointed out that this classification is unsatisfactory, inasmuch as it is yet doubtful "whether there are any specimens of *Solenocaulon* without a stalk". All the specimens we have examined have shown a stalk. The usual habitat of *Solenocaulon* is on sandy or muddy bottom in which the colonies are embedded for several inches by a basal stalk.

Another feature which merits attention is the fusion of the spicules to form

a solid axis. Hickson does not seem to be convinced as to this character, but among our present specimens we can clearly distinguish (1) forms without an axis and (2) forms with an axis.

The mode of branching and the extent to which tube-forming has developed do not in our opinion constitute a specific character. Hickson also holds this view, so that we are surprised at his species, *S. ramosa*, where the only diagnostic feature seems to be the tunnel-like expansions. He says: "The spicules of the axis and of the branches are so remarkably similar to those of the other species that I cannot distinguish them". The degree of retractility of the anthocodæ is also a matter of little importance.

The size and grouping of the verrucæ are of no diagnostic value. The descriptions given below of the various specimens prove this point conclusively.

The architecture of the anthocodæ may, however, be regarded as giving at least a hint to the species. We have studied this in some detail and the results are on the whole satisfactory. A more extended study of other specimens is necessary, however, before any definite suggestions may be made.

All the specimens in the present collection are referred to two species, *viz.*, *S. tortuosum* and *S. sterroklonium*. In *S. tortuosum* there is no hint of an axis, and the characteristic spicules are Y-shaped and irregular. (2) In *S. sterroklonium* there is a distinct fusion of spicules to form an axis and the spicules include spheres.

We incline strongly to Hickson's opinion that *S. tubulosum*, *S. grayi*, and *S. cervicornis* should all be referred to *S. tortuosum*.

***Solenocaulon tortuosum* (Gray).**

A. The largest specimen of this species occurs in the Wood-Mason Collection; it is 260 mm. in height. The basal portion or trunk occupies about 80 mm., and has evidently been embedded in mud; it is slightly expanded at the extremity. The main stem or stalk is tubular in several places while the branches are nearly all tubular throughout. The diameter of the trunk is 8 mm. and the stalk at its widest part is 10 mm. There is only a trace of gutter-like structure on the secondary branches. The verrucæ are small and dome-like; the anthocodæ are almost completely retracted. The polyps are disposed almost exclusively in a single row both on the main stalk and on the margins of the flattened secondary branches. The colour of the colony approaches brick-red but the anthocodæ are white.

B. Several damaged specimens evidently belonging to two colonies of which the trunks have become detached. The stalk-portion of one colony is 100 mm. in length while the detached trunk is 65 mm. The diameter of the trunk is 4 mm., that of the colony is 6 mm. The whole of the stalk is cylindrical, and at

intervals of about 8 mm. it opens out and gives origin to small channelled branches. The polyps occur sparsely and indefinitely but chiefly arise in a single row on the margins of the expansions and the smaller branches. A few, however, occur scattered irregularly on the main stalk. The anthocodial armature is very distinct. The collaret consists of three or four horizontal rows of curved spindles forming definite rings. Surmounting this are eight "points," each consisting of two or three pairs of spindles; these are continued without any break to the aboral surface of the tentacles. In the pinnules the spicules are arranged horizontally. The characteristic Y-shaped spicules are abundant, as also are many irregular spindles.

The colour of the colony is dull brownish-red but the anthocodiae are brown.

Locality: Andaman Sea, 41 fathoms.

C. Two portions of what has evidently been a large colony, the larger of which is 130 mm. in length, the smaller 70 mm. The diameter of the larger is 11 mm. In both cases the stalk and main branches are tubular throughout but the secondaries are flattened. They arise for the most part in pairs and bear their polyps on the upper and lower sides of these respectively. There is a hint in one place of a tunnel-like expansion or "belt" (Hickson).

The polyps occur very closely together almost over the whole colony. In the larger specimen they are confined mostly to one aspect, but in the smaller they arise almost all round the stalk. On the smaller branches they are densely crowded and no trace of arrangement can be seen. The verrucae are very strong and have eight definite triangular "points" composed of clusters of spicules which gradually merge from horizontal to vertical. The anthocodial armature is almost identical with that in specimen B.

The colour of the colony is a dull brownish-red but the polyps are greyish and stand out in bold relief.

Locality: Arakan Coast.

D. A magnificent colony 135 mm. in height, 55 mm. in breadth and 40 mm. deep. The basal portion of the trunk is wanting. The stalk is soft and spongy and contains numerous well-defined canals. A peripheral ring is most distinct, while one runs up the ventral surface of the stalk. The colony is expanded entirely towards its ventral aspect. A marked feature is the expansion in several places into belts from the margin of which arise the greater part of the secondary branches.

The polyps arise almost anywhere throughout the colony, but for the most part in a single row on the lateral margins of the secondary twigs and also on the margins of the belts. They arise also, however, either singly or in groups on both sides of these belts.

The verrucae are large, distinct and dome-like and are over 1 mm. in height.

The anthocodiae are completely retractile within the verrucæ. The armature is very dense. It consists of (1) a collar composed of at least six or seven horizontal rows of curved spindles surmounted by (2) eight triangles each formed of three pairs of spicules arranged "en chevron"; between these there are also a number of spicules which form a transition stage from the horizontal collar to the almost vertical "points".

The colour of the colony is creamy white.

Locality : off Cape Comorin.

E. Two damaged specimens of a pale brown colour, the larger of which is 140 mm. in height, the smaller 105 mm. The trunk is not markedly cylindrical but rather angular and bearing numerous ridges and furrows. It is distinctly flattened on the ventral surface. This specimen approaches in general build to Hickson's *S. ramosa*. There are numerous "belts" or tunnels; one of these is 30 mm. long and 19 mm. high. Small secondary branches arise both from the margins of these and the tubular structures on the main stalk. The polyps are large and distinct and are scattered irregularly over the colony. They arise (1) singly on the main stalk; (2) on branches from the main stalk; (3) irregularly on the expansions, and (4) on the branches which spring from these belts.

The verrucæ are dome-like and about 1 mm. in height. The anthocodial armature is similar to that in D.

Locality : Andamans.

F. A magnificent colony of a cream-white colour, 165 mm. in height. The trunk is 56 mm. long and is expanded at the base; it has evidently been embedded in sand. The whole of the stalk is tubular, and several "belts" occur though not so marked as in some of the other specimens.

The secondary branches and even the tertiaries are extremely long and have a gutter-like structure.

The polyps occur indefinitely and are moderately large. They arise in a single row mainly on the lateral surfaces of the branches but also sparsely on the surface of the "belts".

Locality : Persian Gulf, 48-49 fathoms.

G. In the Wood-Mason Collection are a number of detached fragments evidently secondary branches of a colony similar to F. The verrucæ, however, are extremely large and are closely packed on the margins of the branches though displacement due to crowding in some parts gives the appearance of a double row. Their size is so pronounced as to give a serrated appearance to the margins of the twigs. When partially retracted the anthocodiae sit dome-like on the top of the conical verrucæ.

Previously recorded from the Maldives and Australia.

Solenocaulon sterrokloníum, Germanos.

A. A beautiful colony, 125 mm. in height and 45 mm. in breadth, presents certain very distinctive features. The trunk is 65 mm. in length. It is cylindrical and has been embedded in a bottom composed of coarse sand and shell. At its upper extremity it divides into two main tubular branches so that on the ventral surface a bifurcating tunnel-like opening is presented. Other tubular branches arise from these; their average length is about 8.5 mm. They give origin to small elongated secondary branches which have a gutter-like structure on the dorsal surface.

The trunk is soft and leathery, but the stalk has a central pseudo-axis composed of a hard white, fused mass of spicules. The coenenchyma is brittle rather than leathery.

The polyps are clustered on the ventral and lateral surfaces of the short tubular branches and also on the ventral, not lateral as in most other specimens, surface of the small elongated branches. A few also occur on the lateral surfaces of the two main branches in a single row, thus connecting the groups on the main stem and secondary branches.

The verrucæ are small and dome-like; they are but little differentiated from the general cortex. The spicules are not arranged longitudinally except at the top where there is a hint of eight "points".

The anthocodiae are small and completely retractile. The anthocodial armature is well defined. There is a collar of six to eight transverse rows from which arise eight triangles each composed of two to three pairs of spicules. There is a band of two or three spicules up the aboral surface of the tentacles, and from these arise smaller spindles on the pinnules lying longitudinally, and very definitely developed for each pinnule.

The verrucæ are not so prominent as those figured and described by Germanos, but the spicules exactly correspond to his detailed description.

The colour of the general coenenchyma is white but the verrucæ are pink.
Locality: Yé, Burma.

B. The stalk-portion of a large colony, 125 mm. in length, from which the trunk has been broken. The maximum breadth is 65 mm. Near the base the main stalk gives rise to a branch which is 65 mm. long; it is tubular for 20 mm. after which it forms a gutter-like extension. Numerous small tubular branches also arise from the main stalk; these are very short but from them spring elongated secondary branches which have a distinct gutter on the internal surface. Some of these are over 30 mm. in length. The spicules are fused into a solid axis in the upper part of the stalk, not in the lower.

The polyps are confined to a single row on the margins of the tubular branches and the elongated flattened ones; they also occur on the lateral sur-

faces of the main stalk. The verrucæ are rather small and give an undulating appearance, especially on the secondary branches. They have eight definite triangular oval projections.

The anthocodial armature consists of a collar of six to eight transverse rows, surmounted by eight "points" composed of two, three or four pairs of spindles arranged "en chevron". In addition to this there are two or occasionally three spindles arranged longitudinally on the aboral surface of the tentacles, and this spiculation is continued into the pinnules. The spicules are similar to those in the last specimen.

The colour is yellowish-brown.

Locality : Andamans.

C. (1) Several broken portions of what has evidently been a large colony whose height could not have been less than 250 mm. The trunk is over 80 mm. in length and is much paler in colour than the rest of the colony. It has almost certainly been embedded in mud or sand. The whole of the stalk is tubular, and there is a tunnel-like expansion with a corresponding thinning of the wall; it is considerably flattened in one plane. On the ventral surface it is marked by irregular sinuous ridges and furrows, but on the dorsal surface there is only one median ridge with a central furrow; this furrow is evidently produced by the collapse of a canal wall.

The primary branches are hollow and short. The secondaries are elongated and have a distinct furrow on the ventral surface. The polyps are arranged in a single row around the margin of the short tubular primary branches and also in a single row on the lateral surfaces of the elongated, flattened, secondary branches. A few, however, occur on the lateral surfaces of the main stalk mostly also in a single row. The verrucæ are distinct and dome-like. The anthocodæ are moderately small and are nearly all withdrawn into the verrucæ.

The general tone of the colony is pinkish, but this is due to the verrucæ; the main portion of the cœenchyma is brownish.

C. (2) Several other fragments of a similar nature of a light brown colour occur from the same locality, *viz.*, off Colombo, 26½ fathoms.

D. A slightly damaged specimen 110 mm. in height and 30 mm. in breadth. The trunk, of which the base is wanting, is 25 mm. long and 5 mm. in diameter. The tubular stalk is considerably expanded in several places and reminds one of *S. ramosa*, Hickson. These structures give rise to typical branches which have a ventral furrow. The polyps are sparse and distant; they are separated in many cases by intervals of two mm. or more. They occur mainly on the margins of the branches and the tunnel-like structures, but a few also occur on the lateral surfaces and even on the ventral surface of the main stalk.

The colour of the colony is creamy white but the verrucæ are red.

Numerous small fragments of a salmon-pink colour. The primary tubular

branches are longer than in most other specimens. The secondary branches are typical. On these the verrucæ arise mainly on the ventral surface thus approaching somewhat to A, but on the main stalk they occur scattered irregularly, not in clusters as in A. The verrucæ are small and dome-like. The anthocodiæ are large and have an armature similar to A.

Locality: Andamans, 20 fathoms.

Previously recorded from Ternate.

From the Wood-Mason Collection Miss Harrison¹ has recorded two species of *Solenocaulon*, as follows:—

“*Solenocaulon tortuosum*, Gray.

“In the collection made by the Trustees of the Calcutta Museum this species occurs in three varieties:—

“In variety A, the lateral branches are short and come off in pairs on opposite sides of the lateral holes. The polyps are non-retractile and project beyond conical calices.

“In variety B, the lateral branches come off very regularly on alternate sides of the main trunk and are tubular at their commencement, becoming two parallel branches facing one another. Polyps non-retractile, but conical; calices not so much developed as in A.

“In variety C, the lateral branches are borne on opposite sides of the lateral holes, and the latter are exactly opposite one another so that a front view of the colony looks like the tail of a kite, and a side view shows a series of holes right through the main trunk. Polyps completely retractile.

“*Hab.*: Bay of Bengal.

“*Solenocaulon ramosa*, Hickson.

“A colony 85 cm. long agrees with Hickson’s diagnosis in every point except the greater size of the colony and the absence of all colouring matter.

“*Hab.*: Bay of Bengal.”

¹ Harrison, “*Jour. Linn. Soc.*” (Zool.) vol. xxx. March, 1908.

Table of Species of *Solenocaulon*.

Species.	Mode of Branching.	Axis.	Cœenchyma.	Verrucæ.	Polyps.
<i>Solenocaulon tortuosum</i> (Gray).	Solid basal stalk with ridges and other roughnesses; divides into two stems, first solid, then tubular, giving off tubular or channelled branches, mainly not forming complete channels. In non-tubular, branches and twigs arise from an oval gap in the main channel. Longitudinal grooves in branches and twigs or on middle line where margins join.	Corky, compressible; with colourless rods and spindles. A horny substance in both axis and cœenchyma.	Rough structure, like <i>S. grayi</i> .	On one side only, and restricted to two rows on the channelled twigs; more or less prominently constricted at the middle; there are eight lobes.	White in colour; spicules extend to pinnules.
<i>Solenocaulon tubulosa</i> (Genth).	Tendency to tube-formation.	White, not well defined except in branches, which are rigid. Hyaline matrix.	Brown colour, no horny substance.	In two rows; eight-rayed; on margin of channelled twigs where the margins meet. Polyps have a space between them.	...
<i>S. grayi</i> (Studer).	Partly tubular, partly channelled branches; flexible; largest branches bent down.	White, no horny matrix.	Greyish.	Strongly protruding; mostly in two rows on margins, or where margins meet. Few on main stem.	...
<i>S. sterroklo-nium</i> Ger-manos.	Tree-like, in one plane; partly tubular, partly gutter-like; branches, gutter-like or solid. Solid cylindrical stalk.	Lower part (stalk) cylindrical, with loose, rod-like spicules; upper (stem) with fused spicules.	Lower part leathery, with warty, oval or spherical spicules. Upper part with two layers of different spicules.	Very prominent, but very sparse (1) In one or two irregular rows where the margins of the tube meet. (2) On the margins of the channels in two opposite rows. Mouth has eight unequal lobes with strongly protruding spicules.	Retractile, with spicules up to the pinnules.

Spicules.	Canals.	Colour.	Locality.	References.	Remarks.
<p><i>Cortex</i>: Reddish-yellow spindles, rods, clubs, cylinders, irregular and somewhat divaricate forms. Larger spindles are either rounded, flattened, or curved to one side. All spicules and small cylinders bear irregular branched processes.</p> <p><i>Axis</i>: Colourless rods and spindles.</p> <p><i>Polyps</i>: Majority are broad spindles mostly curved, also rods, clubs and cylinders. Characteristic are extremely irregular curious forms, (1) flattened and Y-shaped, (2) broad and truncate at one end, (3) narrow and almost club-like, (4) tri-radiate, (5) T-shaped, and (6) disc-like, with irregular divaricate teeth. Spicules in cortex and axis mostly longitudinal, and pressed together.</p>	...	Cortex red.	North and North-West Australia; Arafura Sea.	I., p. 34. II., p. 147. IV., p. 668. VI., p. 290. VIII., p. 495. IX., p. 514. XIV., p. 353.	Probably including <i>S. tubulosa</i> , <i>S. grayi</i> , <i>S. cervicornio</i> .
<p>Not fused, except in branches.</p> <p><i>Cortex</i>: Spindles, usually curved and with blunt conical processes. Some club-like, also smaller cylindrical and spindle-shaped forms with close-branched knobbed processes.</p> <p><i>Axis</i>: Partly fused; long spindles, smooth or with few small processes.</p> <p><i>Polyps</i>: Mostly like preceding, but smaller.</p>	...	Greyish-brown.	Philippines.	IV., p. 669. VI., p. 290. IX., p. 511.	Probably not distinct.
<p><i>Cortex</i>: Rods and fir-cone-like; latter with long pointed processes. Rods, usually straight, occasionally curved.</p> <p><i>Axis</i>: Spindles, more flattened and with fewer processes.</p> <p><i>Polyps</i>: As above, but without fir-cone-like forms.</p>	Very numerous in cœnenchyma, forming network. In axis, they run in all directions.	Whitish-grey.	North and North-West Australia.	VI., p. 290.	Probably not distinct.
<p>A. <i>Cortex</i>: Of stalk, colourless or pale rose, oval, spherical, spindles, rods, cylinders; strongly tuberculate and warty. Below, spherical and oval predominate; above, spindles and rods.</p> <p>B. <i>Axis of stalk</i>: Free; fine transparent rods, smooth or with few small thorns or tubercles, sometimes confined to a median ring; abundant horny matrix.</p> <p>(Continued on p. 163.)</p>	Ring of oval canals, uniform around the axis. Second ring in medulla of axis and others further in. Wide canals in cœnenchyma, visible to the naked eye.	Red to rose. Axis white. Polyps white.	Ternate.	VII., p. 151. IX., p. 526.	A well-defined species.

Table of Species of *Solenocaulon*—continued.

Species.	Mode of Branching.	Axis.	Cœnenchyma.	Verrucæ.	Polyps.
...
<i>S. diplokalyx</i> Germanos.	No tubular structures; only of gutter type.	Like <i>sterroklonium</i> , but fused spicules of axis and stem continue for a short distance into stalk.	...	Mostly on margin of channelled branches, but some extend to posterior surface.	Very pronounced anthocodial armature.
<i>S. akalyx</i> Germanos.	Stem with a tube; lateral branches mainly in one plane. Branches hollow or solid. Stem flattened, with wide tube. Gaps with a valve-like structure occur at the origin of solid branches.	Corky, white, with loose rod-like spicules with very few thorns.	...	Practically absent.	White, situated in two rows where margins meet. Completely retractile with same structure as in <i>diplokalyx</i> and <i>sterroklonium</i> . Spicules extend to the pinnules.
<i>S. ramosa</i> Hickson.	Flat wing-like "belts" which may fuse. Longitudinal grooves. Structure of axis precisely similar to <i>tortuosum</i>.	...	...	Prominent, on opposite sides of narrow branches, and on margins of "belts".	Completely retractile, hence spiny or hirsute appearance.
<i>S. cervicorne</i> (Gray). (<i>Leucoella cervicornis</i>).	In one plane; may show tubular cavity, but this is restricted to ends of branches and is turned towards the dorsal side. Channels are turned away from polyps.	White; relatively delicate; soft and compressible.	Corky structure (also axis); is exactly the same as <i>tortuosum</i> , and the resemblance is increased by presence of horny substance in the form of irregular and diffuse clumps.	Scattered, or in rows on anterior surface or margins, especially on the channelled branches; form annular warts.	Irregularly distributed.

Spicules.	Canals.	Colour.	Locality.	References.	Remarks.
<p>C. <i>Stem axis</i>: Spicules thoroughly fused. I. Outer layer of coenenchyma same as long forms of A. II. Inner layer like B, but longer and thinner, all longitudinal.</p> <p><i>Verrucae</i>: Large, warty, straight or slightly curved spindles; longitudinally disposed; reddish.</p> <p><i>Polyps</i>: Small warty spindles, forming a collar, gradually becoming upright and forming a point, passing into tentacles. From these latter arise the spicules of pinnules—two to each pinnule.</p>	
...	...	Yellowish-red.	Ternate.	VII., p. 157. IX., p. 526.	Nearest <i>sterroklonium</i> ; perhaps not distinct.
<p><i>Coenenchyma</i>: Yellow-red spindles with varied warts and processes; spindles sometimes inclining to clubs; small spheres and double spheres, also cylinders with long processes mostly on circumference.</p>	...	Reddish.	Ternate.	VII., p. 159. IX., p. 526.	Nearest <i>tortuosum</i> . Differences: spheres and double spheres in coenenchyma; absence of prominent verrucae.
<p>The spicules of the crown and points are more numerous, more closely set, and thicker than in other species. Pinnules of tentacles have stouter spicules than in <i>S. tortuosum</i>.</p>	...	Dark-brown.	Maldives.	VIII., p. 498. IX., p. 526.	Should perhaps be included in <i>tortuosum</i> .
<p>I. <i>Cortex</i>: Spindles, reddish-brown in colour. The larger and rounder are usually bent to one side, and bear small, rather thickly set tubercles. The smaller spindles of the coenenchyma are more flattened and have small tubercles. Smaller spindles predominate.</p> <p>II. <i>Axis</i>: Colourless, elongated, with small, not very numerous, tooth-like processes.</p> <p>III. <i>Polyps</i>: As in the cortex, but there are also irregular spindles.</p>	...	<p><i>Cortex</i>: dark brown.</p> <p><i>Axis</i>: white.</p>	...	XII., p. 488. IX., p. 518.	Should be included in <i>tortuosum</i> .

Family *SCLEROGORGIDÆ*.*Suberogorgia köllikeri*, var. *ceylonensis*, Thomson.„ *verriculata*, Esper.„ *ornata*, n. sp.*Keroeides koreni*, Wright and Studer.

GENUS SUBEROGORGIA, Gray.

***Suberogorgia köllikeri*, var. *ceylonensis*, Thomson.**

Two slightly damaged colonies 70 mm. × 40 mm. and 65 mm. × 40 mm. in length and breadth respectively. They are of a yellowish-brown colour but the younger twigs are almost grey. Both have discs of attachment and the cœnenchyma extends over the rock for a considerable distance. The branching is in one plane but quite indefinite. The cœnenchyma is finely granular. The polyps occur mainly on the lateral aspects of the branches, but on the older parts they are disposed all round; they are absent, however, on the lower part of the main stem. The verrucæ appear as warts flattened in the plane of ramification and give the surface an undulating contour. The spiculation and other details agree with those given for the type in the “Ceylon Pearl Oyster Fisheries Report,” Appendix D.—Alcyonaria. Supp. Report XXVIII.

Locality: Andamans, 270-45 fathoms.

S. köllikeri, previously recorded from Japan, “Challenger”; var. *ceylonensis*, Ceylon Seas, Herdman; var. *zanzibarensis*, Zanzibar, Crossland.

***Suberogorgia verriculata*, Esper.**

Several magnificent specimens of this well-known species occur in the Wood-Mason Collection. The largest is over 300 mm. in height. All are expanded in one plane. The colour varies from creamy white to brown when in spirit. The abundant anastomosis and the distinctive anthocodiæ give the colony a characteristic appearance.

Previously recorded from Japan and Australia.

***Suberogorgia ornata*, n. sp. Plate II. figs. 7d and 7b.**

We refer to this new species a number of specimens from different localities.

All are of a brownish colour except in certain places where there are segregations of small spicules on the surface which present a white glistening appearance. The two largest colonies measure 150 mm. in height by 70 mm. in breadth, and 140 mm. in height by 70 mm. in breadth; the second is the more perfect specimen. They are branched in one plane and anastomose freely forming an open network. The thickness of the stem and branches hardly varies

throughout the colony, but it is about 2 mm. in the first and 4 mm. in the second. In the largest colony there is a main stem which extends vertically to an equal height with the branches. Near the base two large branches are given off almost perpendicularly, and from these arise secondary branches which extend sub-parallel to the main stem. This type of branching is continued indefinitely. The smaller branches, however, arise at varying angles and anastomose with the sub-parallel branches forming an open network.

In the other colony the main stem is only 15 mm. long and immediately divides into two almost horizontal branches. The rest of the branching is in a general way similar to that in the first specimen.

The cœnenchyma is thick and densely packed with spicules. It appears as if covered with small warts which are projecting groups of spicules. These are sometimes packed together so closely that they form longitudinal ridges and depressions.

The axis is brown in colour and varies in diameter in one colony from 5 mm. at the base to 0.02 at the tips of the branches. It is very calcareous and appears almost sclerogorgic, being built up of long strands which have a glistening appearance when viewed with reflected light.

The polyps are scattered over the whole surface at intervals of less than 1 mm. The verrucæ are almost inconspicuous being nearly level with the cœnenchyma. The anthocodiæ are completely retractile and when retracted the walls of the verrucæ close over them forming an indistinct eight-rayed star. When partially retracted, the tentacles being infolded, they are cylindrical in form and measure 0.5 mm. in height by 0.5 mm. in diameter. At the base of the tentacles there are eight groups of spicules arranged "en chevron". Each group consists of four pairs of spicules, enclosing angles which increase from above downwards, gradually merging into a horizontal collaret of three to four rows of bent spindles.

The spicules of the cœnenchyma present the following types with measurements in millimetres :—

(a) Stellate forms, 0.04×0.04 .

(b) Spindles with warts closely packed in whorls, 0.1×0.03 ; 0.09×0.04 ; 0.11×0.03 .

(c) Spindles with four whorls of warts, 0.1×0.02 ; 0.08×0.02 .

(d) Double clubs, 0.05×0.03 ; constriction 0.015.

0.03×0.03 ; „ 0.005.

0.03×0.025 ; „ 0.005.

(e) A few minute irregular crosses with the \times very marked, 0.075×0.05 ; 0.05×0.045 .

The spicules of the collaret and triangular groups of the anthocodiæ are slightly spiny spindles measuring in millimetres 0.18×0.01 ; 0.15×0.02 .

Locality : Andaman Sea, 19 fathoms.

Another reticulate colony is 170 mm. in height and 90 mm. in maximum breadth. The main stem, which measures 3.5 mm. in diameter, arises from a spreading base ; it reaches a length of 45 mm. and then bifurcates, one of the branches ascending the whole length of the colony, the other after a distance of 12 mm. becoming indistinguishable from the smaller branches. The branching is irregular, forming a flabellate colony by the anastomosing of the sinuous branches. The meshes are large and for the most part quadrangular, but triangular and pentagonal shapes also occur.

The cœnenchyma is thick and presents a beautiful sculptured appearance in the form of short irregular ridges or almost hemispherical papillæ. These ridges are sinuous sometimes passing up the verrucæ and appearing as teeth on the edge. They are formed of segregations of spicules and appear white against the brown background.

The polyps are scattered over the whole cœnenchyma at varying intervals. In the smaller twigs they are sometimes clustered, at other times placed at intervals of 1 mm. The verrucæ are short and cylindrical and have the same ornate structure as the cœnenchyma. The anthocodiæ are almost wholly retractile. When expanded the tentacles are seen to be brown in colour and without spicules. At the base of these there are distinct triangles formed of long spindles arranged "en chevron"—four to six pairs in each "point". No distinct collaret could be found owing to the extreme brittleness of the polyp. When the tentacles are retracted the "points" form a horizontally disposed eight-rayed operculum.

The axis is brown in colour and is made up of large smooth hyaline spicules with blunt ends. It is not penetrated by solenia.

The general colour of the colony is light brown and is interrupted by sculpturing visible to the naked eye.

The spicules are of the following types, with measurements length by breadth in millimetres :—

Long warty spindles, 0.11×0.025 ; 0.12×0.025 .

Short and thick warty spindles, 0.06×0.035 ; 0.07×0.035 .

Small warty double clubs, 0.03×0.02 ; constriction 0.005 in diameter.

0.035×0.03 ; ,, 0.01 ,, ,,

0.03×0.0175 ; ,, 0.0075 ,, ,,

Small double wheels with warty "hubs," 0.04×0.0275 ; 0.04×0.025 ; 0.045×0.025 .

The spindles of the anthocodiæ are not so warty as those of the cœnenchyma, they measure 0.1×0.02 ; 0.12×0.0175 .

This species is allied to *S. verriculata* but differs from it especially in the sculpturing of the cœnenchyma and in the details of spiculation.

Locality : Andamans.

Belonging to this species there is another colony from the Andamans 100 mm. in height and 90 mm. in maximum breadth. It is branched in one plane and anastomoses to form an irregular mesh-work. The main stem, which is 3 mm. in diameter at the base, is only 4 mm. in length. At this level it gives off two large branches almost at right angles, and these after a wide curve ascend sub-parallel to the main stem. This mode of branching is again repeated, the continuation of the main stem being quite insignificant and fusing after a short distance. The smaller twigs from two almost parallel branches fuse and so form almost rectangular meshes. Towards the outside of the colony the smaller twigs are more sinuous and irregular.

The cœnenchyma presents the characteristic sculptured appearance and this feature may be detected with the naked eye as a finely granular structure. The polyps occur all round the branches and twigs and appear as raised, dark dots.

Locality : Andamans.

In one specimen from the Laccadives the sculpturing is not so pronounced but otherwise the details are essentially the same, *e.g.*, anastomosis, spiculation, etc.

Locality : Laccadives.

GENUS KEROEIDES, Wright and Studer.

Keroeides koreni, Wright and Studer.

Specimens of this species are present in the collection from widely separated localities, *viz.*, Laccadive Islands and Andaman Islands. The only marked difference between them is dimensional.

(a) The Andaman specimens consist of fragments which are very robust and of a dark vermilion-red. They are much broken, the largest measuring 30 mm. \times 30 mm. and 40 mm. \times 15 mm. The stem is about 4 mm. in diameter, the axis 2 mm. In structure the polyps agree with those described by Whitelegge, for *K. gracilis*, Whitelegge, but the largest attain a height of only 2 mm. The branching is irregular; the branches enclose various angles with the stem and are markedly sinuous. The measurements of the spicules coincide with those given by Wright and Studer. It should be noted that the disposition and size of the cœnenchyma spicules differ considerably in different parts of the colony.

Locality : Andamans, off Rutland Island, 35 fathoms.

(b) The Laccadive specimen is of a bright vermilion-red colour and is complete. It is 40 mm. in height and 30 mm. in maximum breadth; it arises from a spreading base and branches in one plane. The main stem is 9 mm. high and 2 mm. in diameter and gives origin to three arc-like branches, averaging about

25 mm. in length, which arise at various angles. These and the secondary branches bear polyps, about 2 mm. high, alternately on the two lateral margins. The spicules are slightly smaller than in the Andaman specimen.

The spicules are diverse in form ; most of them are spindles with tuberculate warts, varying greatly in the proportions of length and breadth, some straight, others curved, some bifid, others trifid at one end. Besides these there are scale-like, triangular, pear-shaped and diamond-shaped forms. Small spiny spindles on the anthocodiae, and forms intermediate between these and the large coenenchyma spicules occur on the verrucæ.

Locality : Laccadive Island, 30-50 fathoms.

A comparison of several specimens of *Keroeides* leads us to the conclusion that Whitelegge's *K. gracilis* lacks sufficient basis. Different colonies vary considerably in vigour of growth, and this is associated with diversities in the branching, in the disposition of the spicules, and in their dimensions. Whitelegge notes that his *K. gracilis* differs from *K. koreni* "in its erect non-pendulous habit and in the characters of its spicules," but Wright and Studer speak of the type as having branches "possibly slightly pendulous," and the differences in spiculation between Whitelegge's *K. gracilis* and the "Challenger" specimen of *K. koreni*, as described by Wright and Studer, are not greater than those between two parts of one of the colonies we have studied.

We therefore suggest that Whitelegge's *K. gracilis* should be included in *K. koreni*, and we would now refer to *K. koreni* the specimens described as *K. gracilis* in "Indian Ocean Alcyonarians," Part I., 1906, p. 22, in "Ceylon Pearl Oyster Report," 1905, p. 287.

Miss Hiles has described a pale colony of *Keroeides* as *K. pallida*; we have not seen this specimen, but her description does not enable us to distinguish the new species from a pale variety of *K. koreni*, of which we have seen several specimens.

This type has been previously recorded from the following localities :—

- (a) As *K. koreni*, *Hyalonema*-ground, off Japan, 345 fathoms (Wright and Studer); Andamans, 270-45 fathoms (Thomson and Henderson).
- (b) As *K. gracilis*, Funafuti (Whitelegge); deep water off Galle, Ceylon (Thomson and Henderson); Andamans, 270-45 fathoms (Thomson and Henderson); Milne Bay, British New Guinea, 20 fathoms (Hiles).
- (c) As *K. pallida*, Talili Bay, New Britain, 40 fathoms (Hiles).

Family *MELITODIDÆ*.*Melitodes variabilis*, Hickson.,, *philippinensis*, Wright and Studer.,, *ornata*, n. sp.,, *pulchella*, n. sp.*Parisis fruticosa*, Verrill.GENUS *MELITODES*, Verrill.*Melitodes variabilis*, Hickson.

This variable species is represented by several characteristically matted specimens, the largest measuring 260 mm. in height, 200 mm. in breadth and 40 mm. in thickness. Since there is no basis of attachment it is difficult to determine exactly what is the nature of the composite mass. It consists of several main stems of almost equal diameter at the base, *viz.*, 3.5 mm. Each of these gives off branches in one plane in an irregular manner but with a hint of dichotomy. At many of the nodes three branches are given off, one extending nearly horizontally and anastomosing with those of another stem, several systems being firmly fused together by numerous connecting branchlets. The whole specimen thus assumes an open matted appearance. It is possible that each of these main stems represents an originally separate colony, the fusion occurring through proximity during growth, but it seems more probable that they all arose from a common reptant basis and formed one immense colony.

The internodes range in length from 1 mm. to 1.5 cm., with diameters of 3.5 mm. and 1 mm. respectively,—the shortest thus occurring near the base. The nodes are prominent and have a greater diameter than the internodes, varying greatly in size and shape in the different parts of the colony. In the branchlets they are hexagonal, while in the main stem and larger branches they are globular, quadrangular or irregular.

The coenenchyma is thin and is granular in appearance, being closely packed with small spicules.

The colour varies considerably and in no very definite manner throughout the colony. In some parts, especially among the smaller twigs, it is red with yellow verrucæ, but in others yellow is the predominating colour for both. This coloration is due to a great extent to the axis appearing through the thin coenenchyma.

The verrucæ are over 1 mm. in diameter and occur mostly in a single row on the lateral surface of the branches; they appear sometimes on the ventral surface, never on the dorsal. They are yellow in colour with few exceptions. The spicules are arranged in eight groups or bands, sometimes encircling the verrucæ, more often disposed longitudinally.

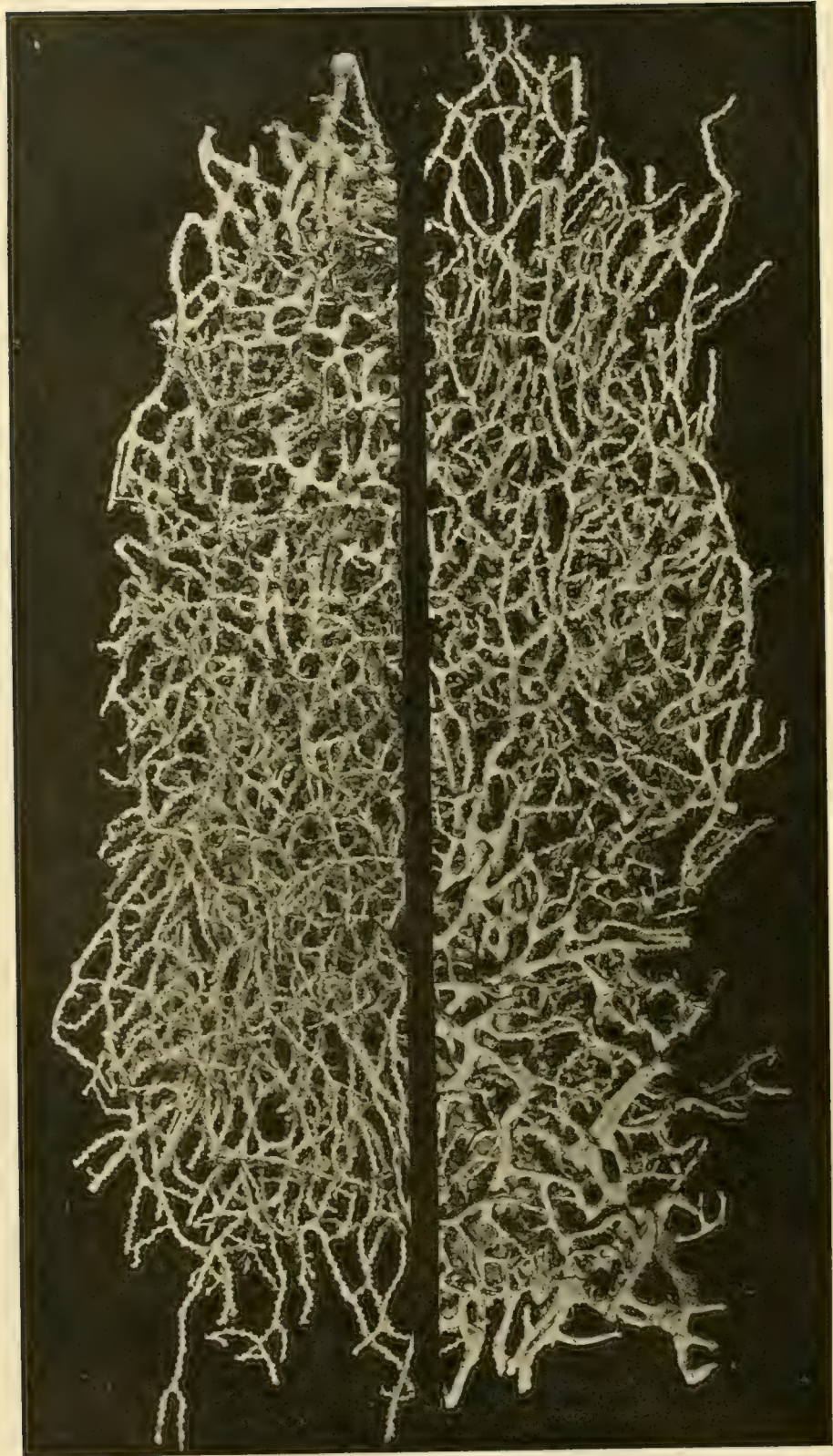


Fig. 73. *Melitodes variabilis*, Hickson.—View of two sides of the large network. Natural size

The anthocodæ are wholly retractile and when retracted give the surface an undulating appearance. There is a distinct "crown and points" arrangement on the basal portion, the "crown" consisting of two or three rows, the "points" composed of four to six spicules arranged "en chevron".

The spicules vary in the different parts and present the following types, with measurements in millimetres :—

(a) Cœnenchyma: transparent, slightly pink or yellowish :—

(1) Very warty thick spindles, 0.18×0.08 ; 0.2×0.05 .

(2) Warty clubs almost foliaceous, 0.25×0.1 ; 0.2×0.05 .

(3) Spindles with very long warts on one side, 0.2×0.15 ;
 0.2×0.12 .

(4) Almost warty spheres, 0.1×0.1 .

(b) Verrucæ—same types, very yellow and slightly larger.

(c) Anthocodæ: (1) "Crown and points"—slightly warty spindles, pale yellow to colourless, 0.3×0.02 ; 0.25×0.02 .

(2) Tentacles—colourless, 0.075×0.01 .

Locality: Gulf of Martaban, 67 fathoms.

There occur also in the collection two fragmentary specimens which we refer to this very variable species. We would therefore add the following notes as to colour, distribution of verrucæ, relation of node to internode, etc.

The larger is 45 mm. in height and 20 mm. in breadth. It is attached to a piece of rock by a spreading base. The branching is a false dichotomy in one plane. The diameter of the lowest internode is 2.5 mm. while that of the corresponding node is 4 mm. ; the first internode is 4 mm. in length, the fourth is 15 mm. The axial portion of the internode is red, that of the node is brown. The cœnenchyma is brownish-red but the polyps are yellow. The polyps occur all round the circumference in an indefinite manner, but in some places they appear only on the lateral aspects.

Locality: Off Table Island (Cocos); Andamans, 15-35 fathoms.

The second specimen is 35 mm. in height and 25 mm. in breadth. The branching is in one plane and falsely dichotomous. The diameter of the lowest internode is 3 mm. ; that of the corresponding node is 5 mm. The lowest internode is 5 mm. in length, while the third is 11 mm.

The axis is red and grooved; the nodes are brown and swollen. The polyps occur indefinitely over the whole surface. The colour of the cœnenchyma is red, that of the polyps yellow.

Locality: Andamans, 270-45 fathoms.

Previously recorded from the Maldives.

Melitodes philippinensis, Wright and Studer.

Plate V. figs. 2 and 4; Plate IX. fig. 12.

A beautifully coloured colony 110 mm. high and 30 mm. in breadth, branching in one plane and anastomosing to form an open network. The branching near the base is irregular, in the upper part of the colony it becomes more decidedly dichotomous. Anastomosis is frequent and takes place in every conceivable manner. The majority of the branches are sinuous but many are almost horizontal, thus joining with the adjacent branch by the shortest route, and giving great inequality in the lengths of the two arms of the dichotomy.

The diameter of the stem is 2·5 mm. at the base, diminishing gradually to 1 mm. in the higher branches. The axis is rough and almost cylindrical. It is bright red in colour and is penetrated by numerous solenia. The internodes vary in length from 3 mm. to 8 mm., but there is no distinct gradation from one part of the colony to the other, the length apparently varying with the anastomosis. The nodes are feebly calcareous and brown in colour. They are almost spherical, forming large swellings, especially in the lower portion of the colony where they measure 3·5 mm. in diameter. In the smaller twigs 1·5 mm. is a common measurement.

The cœnenchyma is thin and densely packed with spicules which present a glistening arenaceous surface. It is of a golden-yellow colour.

The polyps are irregularly disposed, confined to about four-fifths of the surface, leaving a bare space on the dorsal aspect. There is also a hint of a line on the ventral surface. On the nodes polyps are very scarce. They are of a bright coral-red colour and are so thickly set that they give a decided red tinge to the whole colony, in fact the colour of the cœnenchyma can only be distinctly seen on the dorsal surface.

The verrucæ measure about 0·75 mm. in height and the same in diameter. They are dome-shaped but their prominence is due in great part to the contrast in colour with the general cœnenchyma. On the outer surface eight ridges of spicules are seen and these terminate in lobes which meet over the retracted anthocodiæ.

The anthocodiæ are completely retractile. On the base of the tentacles there are four or five pairs of red spicules pointing to the distal end and enclosing large angles. Beyond this the spicules are arranged almost longitudinally and are slightly longer. On the pinnules the spicules are colourless and appear white.

The spicules of the cœnenchyma are pale yellow, and present the following types and measurements in millimetres :—

(a) Warty spindles, 0.2×0.02 ; 0.18×0.02 .

(b) Club-shaped, 0.25×0.03 ; 0.2×0.04 .

(c) Somewhat spherical, 0.05×0.05 .

Verrucae—these are red in colour :—

(a) Very warty spindles, 0.18×0.04 ; 0.15×0.02 .

(b) One-sided warty spindles, 0.18×0.02 ; 0.2×0.03 .

Anthocodia: (a) "Crown and points"—red slightly spiny curved spindles,
 0.22×0.01 ; 0.2×0.01 .

(b) Tentacles—colourless rods, 0.06×0.02 ; 0.065×0.02 .

This species in some respects approaches *M. albitincta*, Ridley, and *M. sulphurea*, Germanos, but the following essential differences may be noted. It differs from *M. albitincta* in that (1) there is no dimorphism; (2) the colour scheme is different; (3) the verrucae are differently distributed. If Ridley's interpretation of the nature of the polyps is correct *M. albitincta* is sufficiently distinct from *M. philippinensis*. In contrast to *M. sulphurea* (1) the polyps are more crowded; (2) the verrucae are less prominent; (3) there is no hint of green spicules; (4) the distribution of the verrucae is different; (5) the colour scheme is reversed; (6) the spicules are more numerous; they bear sharper warts and there are numerous slender bent spindles. After a careful comparison of our specimen with the type specimen of *M. sulphurea* in the British Museum we have decided that the two are distinct.

Locality: Andamans.

Previously recorded from Philippines.

Melitodes ornata, n. sp.

Plate V. figs. 3 and 9; Plate IX. fig. 11.

A large but slightly broken colony of exquisite colouring represents this species. When complete it could not have measured less than 240 mm. in height and 100 mm. in breadth.

Apart from the origin of a few of the lowest branches from the main stem, the whole colony is dichotomously branched, and nowhere is there any trace of anastomosis. The stem near the base is 5 mm. in diameter, but the successive branches gradually diminish in size so that the twigs measure only 1.25 mm. The branching may be described as an unequal dichotomy; the branches arise from the nodes and enclose an angle of about 30° ; one branch is slightly more slender than the other and diverges at a somewhat greater angle from the perpendicular.

The axis near the base is very rough, owing to short deep furrows which extend longitudinally and are discontinuous. These show markedly its composite structure. Towards the tips of the branches this character is not so prominent, but a glistening sheen is produced by reflected light on the project-

ing constituent spicules. The whole axis is penetrated by numerous solenia which appear distinctly as small white tubes especially in the nodal regions. The colour of the axis is a bright coral-red. The internodes are flattened in a plane perpendicular to the plane of branching and vary in length from 1.2 mm. to 1.8 mm., measuring in breadth and thickness 0.5 mm. \times 0.1 mm. and 0.2 mm. \times 0.05 mm. respectively. They are markedly concave at each end, thus forming almost hemispherical cups for the nodes. The nodal regions are somewhat globular, measuring 8 mm. in diameter and 5 mm. in length, the brown horny node itself occurring as a thin plate at the greatest diameter. In the younger branches the nodes are not so prominent but are still distinctly spherical.

The coenenchyma is thin and densely packed with spicules. To the naked eye it appears smooth, but with a low-power microscope it presents a glistening arenaceous surface. The colour of the general coenenchyma is a bright coral-red, but the monotony is relieved by an exquisite setting of golden-yellow rings enclosing a colourless pearl-like centre. The whole is composed of the projecting ends of club-like spicules which by reflected light produce a diamond-like brilliance.

The polyps are scattered over about five-sixths of the stem leaving a bare space on the dorsal surface. They measure about 0.5 mm. to 0.7 mm. in diameter and are separated by similar intervals. They are retractile within slightly projecting verrucæ which would be inconspicuous but for their bright golden-yellow colour. The tentacles are infolded and are covered on their aboral surface with transparent colourless spicules which show up in marked contrast to the gorgeous colouring of the coenenchyma and verrucæ.

The anthocodiæ present an arrangement almost approaching to what might be termed "crown and points".

The spicules of the general coenenchyma are red in colour consisting of several types with the following measurements in millimetres:—

- (a) Warty curved and straight spindles, 0.175×0.03 ; 0.15×0.025 .
- (b) "Stachelkeulen" or "Blattkeulen," 0.1×0.075 ; 0.075×0.075 .
- (c) Double wheels, 0.075×0.075 .

Those of the verrucæ are yellow but many have a red tip embedded in the coenenchyma. They have the following measurements in millimetres:—

- (a) "Stachelkeulen" or "Blattkeulen," 0.175×0.1 ; 0.1×0.1 .
- (b) Warty spindles, 0.25×0.03 .

In the anthocodiæ the spicules are transparent. Some of the measurements are appended:—

- (a) "Crown and points": (1) Almost smooth spindles, 0.2×0.02 .
(2) Warty spindles, 0.25×0.02 .
- (b) Tentacles—Warty scale like forms, 0.1×0.02 .

Locality; Andaman Sea, 19 fathoms.

Melitodes pulchella, n. sp.

This new species is based upon several slightly broken specimens. Three are of a slightly pinkish tint and one is a beautiful white. The white colony measures about 50 mm. in height and 40 mm. in breadth. There are two main stems from a spreading base 2.5 mm. in diameter. From these the remaining branches arise dichotomously. The internodes vary in length from 1 mm. to 1.5 cm.

The largest pink colony is 70 mm. high and 25 mm. in breadth. The branching is approximately in one plane, but in some cases one branch overlaps another. The axis is 3 mm. in diameter at the base, and is very irregular in outline, being penetrated by numerous large solenia and presenting indefinite ridges on the surface. At the tips of the smaller branches the diameter decreases to 1.75 mm. and the outline is more regular.

The branching varies in the different parts of the colony, being indefinite in the older parts, but dichotomous among the secondary branches which enclose an angle of about 30°. There is no trace of anastomosing. The length of the internodes is by no means constant, the first being 1 mm., the second 6 mm., while among the smaller branches 16 mm. is a common length.

The nodes of the main stem are inconspicuous, being of the same diameter as the internodes and hidden by the coenenchyma. In the younger parts they are swollen and prominent, the red colour showing through the coenenchyma.

The coenenchyma is packed with numerous spiny spicules presenting a rough glistening surface.

The polyps are arranged differently in the several parts of the colony. On the young branches they are disposed on the lateral margins, alternate, opposite or indefinite. Further down there are two rows on each side, while near the base they appear on three sides leaving a bare tract on the dorsal surface. They are retractile within verrucæ which are much more distinct on the younger branches. When the tentacles are simply infolded the verrucæ appear like well-developed cylinders, 0.5 mm. high and 0.5 mm. in diameter, over which the dome-like anthocodiæ project, the base being broader than the top of the cylinder. When the anthocodiæ are fully retracted the verrucæ are mound-like and more inconspicuous.

On the verrucæ there are eight ridges formed by segregations of spicules. The anthocodiæ present a structure recalling the "crown and points" arrangement of the *Siphonogorgia* type, there being three or four rows of bent spindles at the base of the tentacles, while on the tentacles themselves the spicules are arranged "en chevron" enclosing an acute angle.

The spicules of the coenenchyma are closely packed together and consist of several distinct types. The following are some of these, with their measurements in millimetres ;—

(a) Long club-shaped spiny spicules, the spines becoming longer towards the thick end and pointing in that direction so that they almost approach "foliaceous clubs," 0.2×0.08 ; 0.15×0.07 .

(b) One-sided spiny spindles, 0.175×0.075 ; 0.125×0.05 .

(c) Spindles with warts almost in whorls, 0.125×0.05 ; 0.1×0.075 .

(d) Small almost stellate forms, 0.05×0.05 .

(e) Double spheres or dumb-bells, 0.075×0.05 ; constriction 0.015 in diameter.

The spicules of the anthocodiae are long slightly spiny curved spindles, those of the "crown and points" measuring in millimetres 0.3×0.03 ; 0.2×0.025 .

Small rods on the aboral side of the tentacles measure 0.04 mm. \times 0.01 mm.

Locality : Gaspar Straits, East Coast of Sumatra.

Parisís frutícosa, Verrill.

(= *Parisís indica*, Thomson and Henderson.)

Specimens of this species occur in the collection from five different localities. As these present certain differences it may be useful to make a few notes on each separately.

(1) Two broken specimens, the first being a basal portion 12 cm. high and 5 cm. broad, with an axial diameter of 8 mm. ; the second 13 cm. in height and 6.5 cm. in breadth, the main axis having a diameter of 3.5 mm. In the first of these the internodes average 5 mm. in length and the nodes 2.5 mm., but in the other the internodes near the base measure 6 mm. long, the nodes only 1 mm. In both the branching is not strictly confined to one plane and is quite irregular. An incrustation of "Palythoa" almost obliterates the whole of the polyps. The colour is a greyish-white.

Locality : Gulf of Martaban, 67 fathoms.

(2) A splendid specimen 14.5 cm. in height and 12 cm. in diameter. The branching is irregular and is confined to one plane, giving the whole colony a very flabellate appearance. The branches arise at an angle of about 45° . The internodes near the base measure 4 mm. and the nodes 2 mm. The grooving is very distinct. The polyps are not so markedly confined to the lateral branches. The whole colony is overgrown by an incrusting siliceous sponge whose spicules project on the surface. The colour is greyish-white.

Locality : Andamans. Marine Survey.

(3) Two specimens, each with a basal attachment, measuring 14.5 cm. high by 5.5 cm. broad, and 8.5 cm. high by 5 cm. broad, with basal diameters of 6 mm. and 4 mm. respectively. In both the branches arise at right angles, but in one they turn upwards almost parallel to the main stem. The internodes measure

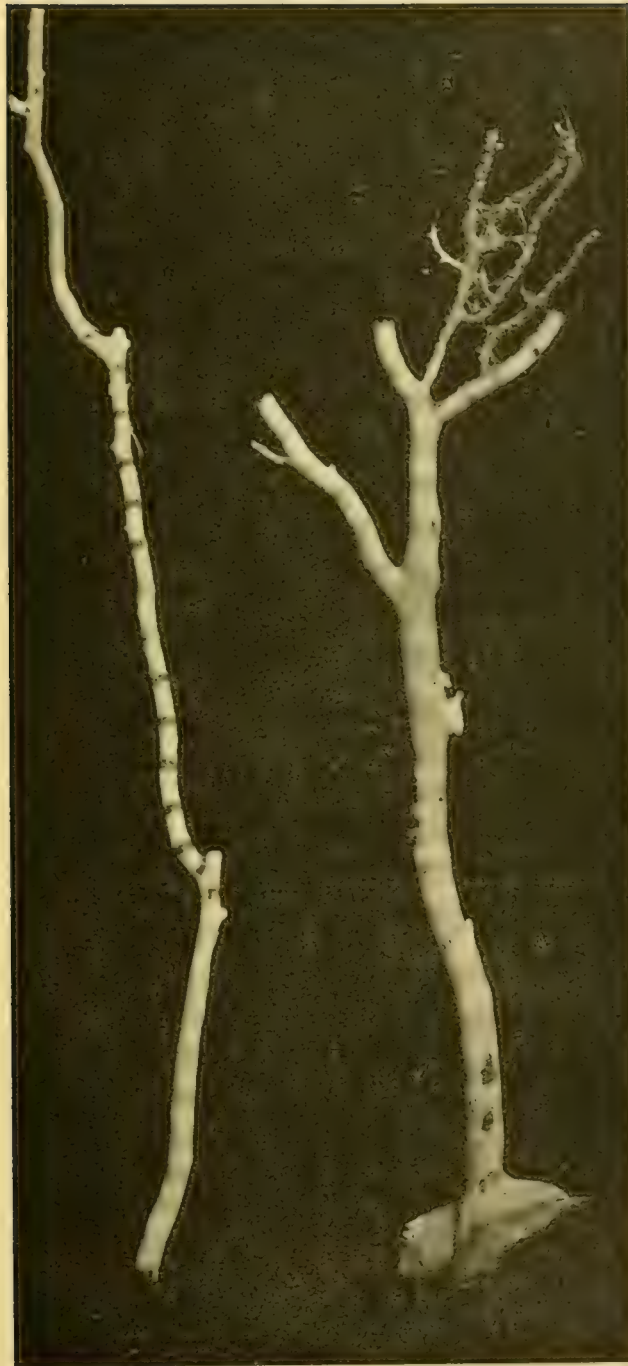


Fig. 74. *Parisia fruticosa*, Verrill.
Main stem and branch showing the difference in the proportions of nodes and internodes.

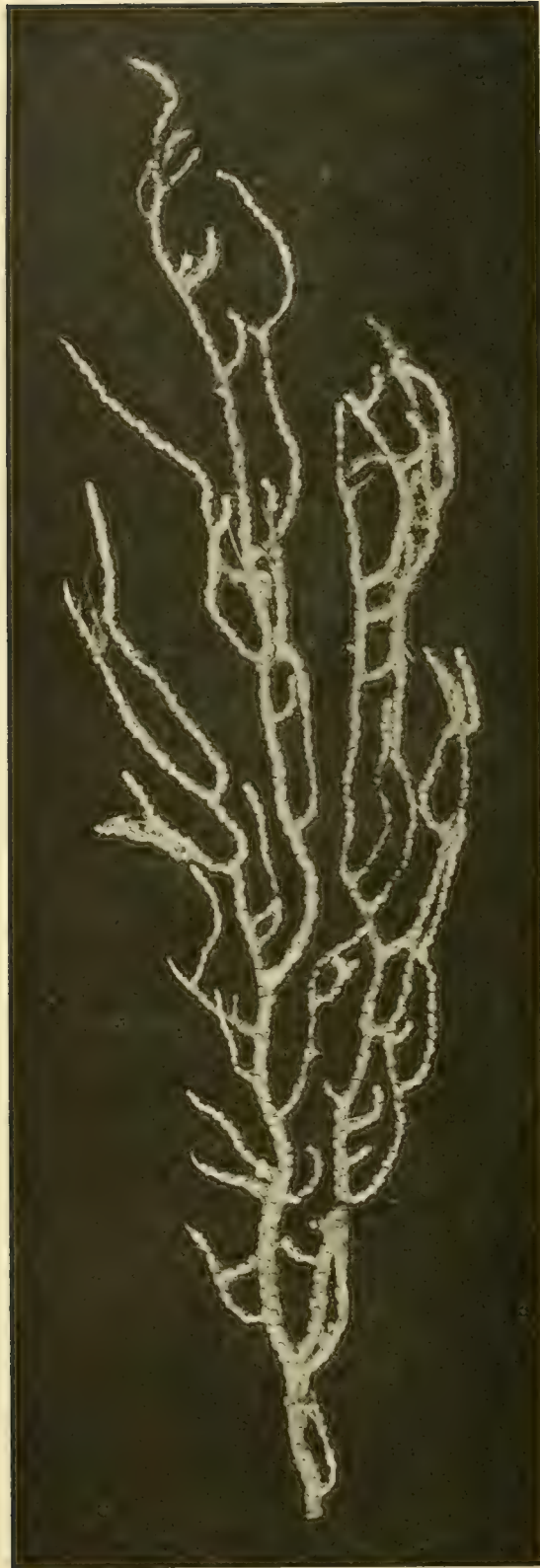


Fig. 75. *Parisis fruticosa*, Verrill.
Portion of colony showing the mode of branching
and the encrusting Palythoid.

in both cases 4 mm. and the nodes 2 mm. These specimens are free from any incrustation. The colour is greyish-white.

Locality : Persian Gulf, 48-49 fathoms.

(4) and (5) The only point in which these differ from the previous specimens is in the colour, which is creamy-white. They are also free from incrustation.

Locality : Persian Gulf, 4 fathoms.

In the specimen from the Andamans many of the polyps were protruded, and a few notes on these may be of interest.

The anthocodiae measure about 2 mm. in height, *i.e.*, above the tops of the verrucae. The tentacles bear only one row of pinnules and are about 1 mm. in length ; there are no spicules on either surface. At the base, however, there is a pattern which closely resembles the well-known "crown and points," passing into a series of rows of spicules round the tubular portion.

A study of these numerous specimens has led us to the conclusion that *P. indica*, Thomson and Henderson, should be included in *P. fruticosa*.

It may be worthy of note that incrustation of *Palythoa* has been noted from such widely diverse localities as Ki Islands (*P. fruticosa*, Verrill), Port Jackson (*P. australis*, Wright and Studer), Andamans (*P. fruticosa*), also from the Gulf of Martaban (*P. fruticosa*). Another incrustation in the form of a sponge covers *P. australis* from Port Jackson and *P. fruticosa* from the Andamans. The specimens taken in the Persian Gulf at three separate stations exhibit no traces of the Sponge parasitism, for such it was considered by Wright and Studer, who remark that the encrusting sponge on *P. fruticosa*, Verrill, gradually destroys the colony.

Previously recorded from : Australia, Banda Sea, Sulu Sea, Formosa and the Indian Ocean.

ORDER IV. AXIFERA, G. von Koch.

Family *PRIMNOIDÆ*.

Sub-family Primnoinæ.

GENUS CALIGORGIA, Gray.

Caligorgia indica, Thomson and Henderson.

To this species we refer several fragments from two different localities. The largest is 80 mm. in length and 10 mm. in maximum breadth, while another is 40 mm. in length and 10 mm. in breadth. The axis is iridescent and bears longitudinal ridges and grooves. The branching is dichotomous in one plane. The polyps occur in whorls of two or three, the latter number being more frequent, probably owing to the fact that the specimens are but terminal fragments. For a comparison between this species and *C. verticillata*, Pallas, and *C. similis*, Versluys, see "Acyonarians of the Indian Ocean," Part I. p. 43.

Localities: Andamans, 270-45 fathoms, and Laccadives, 30-50 fathoms.

Previously recorded from Andamans, 270-45 fathoms.

Family *ISIDÆ*.

Sub-family Isidinæ.

GENUS ISIS, Linnæus.

Isis hippuris,¹ Linnæus. Plate VI. figs. 1, 2 and 3.

The genus *Isis* was established by Linnæus in 1737 in his "Hortus Clifortianus," p. 479, but he did not then include under the generic appellation the species to which it was afterwards applied. These he referred to the genus *Sertularia*. In his "Systema Naturæ," ed. x., 1758, p. 1287, Linnæus rearranged his species, and placed in the genus *Isis* not only the species referred to, but also all the Isidinæ, "le Corail" as well as the Encrinites. Pallas, in his "Elenchus Zoophytorum," 1766, accepted the classification of Linnæus and gave the following generic description: "Colony arborescent, sedentary; axis calcareous, porous with longitudinal striations, or jointed, bearing a fleshy cortex; verrucae sparsely scattered; polyps flower-shaped, oviparous, with a crown of tentacles,

¹The account of *Isis hippuris* and of the history of the genus *Isis* is due to Mr. Simpson: see "Journ. Linn. Soc." (Zoology), xxxvii. (1906), pp. 421-33, 1 pl.

retractile". Under this category he placed the following species : *I. nobilis*, *I. dichotoma*, *I. ochracea* and *I. hippuris*. In 1786 Ellis and Solander, in "The Natural History of Many Curious and Uncommon Zoophytes," p. 105, defined the genus in the following terms : "An animal growing in the form of a plant whose stem is stony and jointed; the joints are furrowed longitudinally and united together in some by a spongy, in others by a horny substance. It is covered over by a soft porous and cellular flesh, full of little mouths from whence the polyps with their claws come forth, through whom the eggs are produced." They also noted the relationship between this genus and the Gorgonids, a relationship based on the presence in both of "the axis, support or bone of the animal"; the only difference being the presence of joints in that of the genus under consideration, while in the latter the axis is horny throughout. They suggest that the "articulation" of the axis is an adaptation for swaying in the water, flexing backwards and forwards in the currents, and so minimising the possibilities of fracture. To these eminent naturalists we are also indebted for the first figures of any species of this genus, Tab. 3, figs. 1-5, representing various parts of *I. hippuris*, Linnaeus. The only other species described by them are *I. ochracea* and *I. coccinea*. It is also to Ellis and Solander that we are indebted for the introduction of the terms nodes and internodes; but it must be noted that these are used to describe the calcareous and horny parts respectively, whereas the converse usage is now adopted. The following is their description : "Axis articulated, calcareous, sparsely branched; the calcareous portion is white, cylindrical and furrowed; the internodes are black, horny, constricted and attached to the nodes". In 1791 Esper depicted the axis in three fine plates, and gave a good general description of external features. Lamarck, in 1801, placed this group between the Gorgonacea, with an axis apparently horny, and the "Corail," with an entirely calcareous skeleton. In a later work, published in 1816, he narrowed down the generic distinctions and established a new group, "les Mélitées" (genus *Melitea*). Following this, Lamouroux in the same year established yet another division under the name of "les Mopsés" (genus *Mopsea*); and at the same time united the three under "l'ordre des Isidées," i.e., "tous les Coralliaires dont l'axe est articulé". This innovation was not accepted by Blainville in 1834 (XVI.), but was adopted by Ehrenberg 1834 (XVII.), Lamarck 1836 (XII.), Dana 1846 (XIX.), and Milne-Edwards and Haime in subsequent works (XX., XXI. and XXII.).

The classification would thus appear as follows :—

Isidinae, with an axis which bears internodes	{	(a) horny in appearance. Branches borne on	(1) the calca- reous nodes = <i>Isis</i> .
			(2) the horny internodes = <i>Mopsea</i> .
		(b) of a suberous appearance	. . . = <i>Melitea</i> .

Lamarck's "Hist. Nat. des Anim. sans Vertèb.," 2nd ed., 1836, vol. ii. p. 473, thus defines the genus: "Colony attached, tree-like, composed of a jointed axis surrounded by a cortex not cohering but deciduous. Axis central, erect, branched, formed of calcareous striated *nodes* and horny constricted *internodes*. The cortex bears polyps in the fresh state, but is totally or partially deciduous when taken from the water." The writer discusses the question of relationship, and from the presence of horny internodes suggests affinity with *Gorgonia* and *Antipathes*, in which, he remarks, the axis is not calcareous but entirely horny. Brief notes on the following species are also given: *I. hippuris*, Linnæus; *I. elongata*, Esper; *I. dichotoma*, Linnæus; *I. encrinura*, Lamarck; *I. coralloides*, Lamarck; *I. gracilis*, Lamarck; *I. erythræa*, Lamarck; and *I. melitensis*, Lamarck.

Dana, in his "Zoophytes," 1846 (XIX.), thus limits the genus: "Isinæ consisting of corneous and calcareous joints alternately; branches proceeding from the calcareous joints; cortex thick, deciduous".

In 1857 Milne-Edwards and Haime (XXII.) defined the genus in the following terms: "Colony with axis alternately calcareous and horny; calcareous portions sclerobasic, varying in length according to the specimen and having horizontally disposed ridges straight or bent; branches borne on the calcareous portion". At the same time they refer briefly to two new species established by Steenstrup, *viz.*, *I. polyacantha* and *I. moniliformis*, as well as to the older species *I. coralloides*, Lamarck, and *I. elongata*, Esper.

It will be seen that, up to this point, no account has been taken of the spiculation; but in the "Proceedings of the Zoological Society," 1857, Gray gives the following important though indefinite addition: "Bark thick, with a few interspersed very irregular and unequal spicula". His remarks on two other points of structure are also very relevant and cannot be overlooked: (1) that the bark is permanent and hard, but is brittle and easily removed, especially if the specimens be kept in a dry place: hence Lamarck's "caduce en totalité"; (2) sometimes the horny parts become obliterated by an excessive growth of the calcareous portion, and this may account for Lamarck establishing the genus *Cynosaire* ("Mém. Mus. Hist. Nat.").

In the same work Gray also established the genus *Isidella*, into which he merged no fewer than four of Lamarck's species of *Isis*. The following is Gray's diagnosis of *Isidella*: "Coral branched, furcate. Axis smooth, cylindrical; stony joints elongate; branches furcate, proceeding from the corneous joint. Bark rather thick, with irregular opaque spicula; polypiferous cells produced, subcylindrical; base of axis expanded, lobed and branched."

The genus under consideration had thus received its position from the nature of its axis, with but indefinite knowledge of cortex, polyps and spicules; but in 1865 Kölliker, in his "Icones Histiologicæ," rendered this part of the

work more precise by his introduction of a more definite spicular basis of classification. The following gives precisely his important addition : "I know only the spicules of the cœnenchyma of *I. hippuris*, which exhibit spindles beset with spiny warts, of which the simplest are in sixes, eights or twelves. Some are simple clubs, and probably represent those of the cortical layer. The warts on one side are smaller than those on the other. Tetra-radiate forms are not uncommon. The size of the largest spicule is 0·18 mm." The only other species referred by him to this genus are *I. moniliformis*, Steenstrup, *I. gracilis* (*Mopsea gracilis*), Lamouroux.

Studer in 1878 established a new species, *I. antarctica*, and G. von Koch, in 1887, referred to this genus another form under the name *I. neapolitana*. Of this and of the closely allied *Isis elongata* (Esper), von Koch gave a detailed description, eventually deciding, however, that both should be referred not to *Isis* but to *Isidella*.

Wright and Studer, in the "Challenger" Report," vol. xxxi., 1889, tersely sum up the characters of *Isis*, and accept Kölliker's description of the spicules of *I. hippuris* as typical of the genus, placing it in the Family Isidæ, Sub-family Isidinæ. At the same time the genera *Primnoisis* and *Callisis* were added to the classification, and this necessitated the abolition of certain species formerly placed in the genus *Isis*.

Thus we see that since the genus was established by Linnæus in 1737 no fewer than nineteen species have been added by various authors, but, strange to say, only one now remains as an authentic species, *viz.*, *I. hippuris*, Linnæus. The following table represents these species, the second column indicating their place under the present system of classification and nomenclature :—

<i>Isis antarctica</i> , Studer, 1878.	<i>Primnoisis antarctica</i> , Wright and Studer, 1889.
<i>I. aurantia</i> , Esper, 1797.	<i>Melitæa aurantia</i> , Gray, 1857.
<i>I. capensis</i> , Studer, 1878.	<i>Primnoisis capensis</i> , Wright and Studer, 1889.
<i>I. coccinea</i> , Esper and Studer, 1786; Gmel.; Esper.	<i>Melitæa coccinea</i> , Gray, 1857.
<i>I. coralloides</i> , Lamarck, 1836; Milne-Edwards and Haime, 1857.	<i>Isidella</i> (?) <i>coralloides</i> , Gray, 1857.
<i>I. dichotoma</i> , Linnæus, 1737; Lamarck, 1836.	<i>Mopsea dichotoma</i> , Wright and Studer, 1889.
<i>I. dichotoma</i> , Pallas, 1760.	<i>Melitodes dichotoma</i> , Wright and Studer, 1889.
<i>Mopsella dichotoma</i> , Gray, 1857.	
<i>I. elongata</i> , Esper, 1797; Milne-Edwards and Haime, 1857; Lamarck, 1836.	<i>Isidella elongata</i> , Gray, 1857.
<i>I. encrinula</i> , Lamarck, 1836.	<i>Mopsea encrinula</i> , Gray, 1857.
<i>I. erythræa</i> , Lamarck, 1836.	<i>Isidella elongata</i> , Gray, 1857.
<i>I. flexibilis</i> , Pourt., 1868.	<i>Callisis flexibilis</i> , Wright and Studer, 1889.
<i>I. gracilis</i> , Lamarck, 1836; Lamouroux.	<i>Isidella elongata</i> , Gray, 1857.
<i>I. gregorii</i> , Gray, 1868.	

- I. hippuris*, Linnæus, 1758; Pallas, 1766; and Studer, 1786; Milne-Edwards and Haime, 1857; Gray, 1857; Kölliker, 1865; Wright and Studer, 1889. *Isis hippuris*, Linnæus, 1758.
- I. melitensis*, Lamarck, 1836.
- I. moniliformis*, Steenstrup; Milne-Edwards and Haime, 1857.
- I. neapolitana*, von Koch, 1887. *Isidella neapolitana*, G. von Koch, 1887.
- I. nobilis*, Pallas, 1766; Lamarck, 1822. *Corallium rubrum*, Lamarck, 1801.
- I. ochracea*, Linnæus, 1758; Pallas, 1766; Esper, 1797; Gmel.; Esper and Studer, 1786. *Melitæa ochracea*, Gray, 1857.
- I. polyacantha*, Steenstrup; Milne-Edwards and Haime, 1857.

I. gregorii, *I. melitensis*, *I. moniliformis* and *I. polyacantha* are almost names without descriptions, and so cannot with certainty be referred to their proper place in classification.

ISIS HIPPURIS.

1608. *Hippuris saxea*, Clusius, I. p. 124.
Corallium album articulatum, Seba, t. iv. p. 202, Plate CX. fig. 1.
1737. *Sertularia ramosissima*, Linnæus, II. p. 480.
Isis hippuris, Linnæus, 1758, III. p. 799; Pallas, 1766, VI. p. 233; Ellis and Solander, 1786, VII. p. 105, Plate III. fig. 1; Esper, 1797, VIII. tom. i. p. 279, Plate I. Plate II. Plate IIIa. figs. 1-5; Lamouroux, 1816, XIV. p. 475; Lamouroux, 1821, XV. p. 59, Plate III. fig. 1; Lamarck, 1816, XI. tom. ii. p. 302; Blainville, 1834, XVI. p. 503, Plate LXXXVI. fig. 1; Lamarck, 1836, XII. p. 475; Steenstrup, XVIII.; Cuvier, Règne Anim. tom. iii. p. 312; Dana, 1846, XIX. p. 144; Milne-Edwards and Haime, 1857, XXII.; Gray, 1857, XXIII. p. 283; Kölliker, 1865, XXIV. p. 140, tab. 19, figs. 42 and 43, tab. 16, fig. 4; Wright and Studer, 1889, XXXII.

In 1766 Pallas, in his "Elenchus Zoophytorum," gives a brief description of *Isis hippuris* in the following terms: "Axis articulated, alternately branched; cortex thick and slightly porous". Twenty years later Ellis and Solander, with their usual precision and careful observation of detail, describe some specimens obtained at Sunda and Sumatra. Their somewhat lengthy description (*i.e.*, in comparison with the usual terse and contracted diagnoses of the time) is well worth quoting: "Jointed stony stem, which rises into many loose branches. The bone or support of the animal consists of white, cylindrical, stony, channelled joints connected together by black contracted horny intermediate ones. The flesh is whitish, plump and full of minute vessels; the surface of it is full of the little mouths of the cells which are disposed in a

quincuncial order, covering the polyps with eight claws. In length they vary from five inches to one or two feet or more. In some the stony joints are longer and the black horny joints very short; in others the black horny joints are longer but always more contracted. The coral spreads its base on rocks by various turnings and windings both of its bony and fleshy part, and likewise as it rises we find it enclosing shells and other extraneous substances, that stick to it, like the *Gorgonias*." To Ellis and Solander we are also indebted for the only figures of this species showing the *cœnenchyma*. These are reproduced by Esper and supplemented by fine figures of the skeleton.

In 1821 Lamouroux specifies it as follows: "Branched, branches few in number; cortex thick; polyps not having protruding verrucæ; axis articulated, nodes calcareous, with irregular longitudinal striations, internodes horny".

The new edition of Lamarck, in 1836, practically adds nothing to the description, but emphasises Ellis and Solander's points thus: "Cortex thick, non-prominent verrucæ, polyps with eight tentacles (claws)". Ten years later Dana referred to this species several specimens from the East Indies, but does not in any way give more precision to the diagnosis.

The next and last reference to newly-collected and authentic specimens is made by Milne-Edwards and Haime, who, in 1857, thus defined the species from specimens collected at Amboina: "Colony large and branched, branches elongated, almost straight; calcareous nodes subcylindrical, elongated, two or three times longer than broad, with sinuous striations; internodes very short and horny". In 1865, however, Kölliker, in revising the *Aleyonaria* in his "*Icones Histiologicæ*," makes reference to the spicules of this species. He says they consist of (1) spindles beset with spiny warts, of which there may be six, eight or twelve on each; (2) simple clubs, probably representing the cortical layer, with the warts on one side longer than those on the other. The size of the largest spicule is 0.18 mm. Wright and Studer found no specimens of *Isis* in the collection made during the "Challenger" voyage, but they give the following diagnosis, which is the last systematic reference to the genus: "Colonies branched, with thick *cœnenchyma*, within which the polyps can be wholly withdrawn. The spicules are radiately stellate and covered with rough warts, of which there may be six, eight or twelve on each. Some simple club-like forms also occur."

From the foregoing considerations it is at once evident that *Isis hippuris*, though in a sense well known, has been very imperfectly described. It is hoped that the following observations may give more precision and definiteness to a species, the sole representative of a distinct family.

The specimens in this collection are almost all of a light brown colour which in the dry condition appears as buff or ochreous-yellow. In some of

the specimens which have been damaged and are apparently decayed the coenenchyma is almost white.

As the colonies under examination present certain differences *inter se*, and at the same time do not altogether conform to the figures given by Ellis and Solander and reproduced by Lamouroux, it will be useful to make a few general notes on the more typical specimens, before discussing in detail the features of more diagnostic importance.

The following measurements were taken of the height, breadth and thickness, in centimetres :—

(a) $9.5 \times 8 \times 3.5$. (b) $9 \times 6 \times 4$. (c) $7 \times 6 \times 3$. (d) $10.5 \times 4 \times 2$. (e) $6.5 \times 7 \times 4$. (f) $5.5 \times 4 \times 4$. (g) $6 \times 4 \times 3$. (h) $6 \times 4 \times 3$.

In the largest and most complete specimen (Plate VI. fig. 1) the branching is somewhat antler-like and is mostly confined to three planes, so that the great majority of the branches are directed towards one surface. The main stem is 8 mm. in diameter, and about 3 cm. from the base two large branches arise at slightly different levels. The sinuous nature of the branches is a marked feature in this colony, the branches themselves being separated by distances of about 5 mm. The secondaries and tertiaries are short, thick and cylindrical for the greater part of their length, but have characteristic steep conical terminations. One of the larger branches is devoid of coenenchyma, and shows clearly the internodal origin of the subsidiary branches.



Fig. 76. Part of a colony of *Isis hippuris*, showing the palmate terminations of the twigs. Natural size.

A second specimen, which is incomplete, consists of part of a main stem 6 cm. in length, from which several branches arise in all directions. Of these, however, only one, which is 9 cm. in length, bears the terminal twigs intact. The branches spring from the main stem at varying angles, about 45° being the most frequent. The large complete branch curves inwards towards the main stem and gives origin to several smaller branches, some of which remain simple while others bear curved twigs.

The third of the specimens whose measurements are given may be regarded as the most typical, although it is evidently only the terminal portion of a large colony. It is very robust and bushy in appearance and maintains a marked upward growth. The main branch is 8 mm. in diameter, and gives origin to several almost equal branches of about 5 mm. in diameter. From

these the secondary twigs diverge in all directions, but all have their growing tips pointing upward. The average diameter of these is about 3.5 mm. at their origin, but many terminate in club-shaped processes which increase this measurement to about 6 mm. Owing to excessive growth in the coenenchyma, the angle between a twig and its support becomes almost obliterated; so that a branch presents a somewhat palmate appearance, with short blunt digitiform processes—the growing tips of the twigs (Plate VI. fig. 2).

The next largest specimen is much damaged and may be the basal portion of a very large colony. The main stem, which is incomplete, is 7 cm. long and has a diameter of 9 mm. at the base, diminishing to 4 mm. at the broken tip. The branches which arise from it do not seem proportionate to the main stem, but there is evidence of the broken remains of larger branches now quite overgrown by the general coenenchyma. The sinuous and cylindrical character of the branches is a marked feature.

The other four colonies whose measurements are given agree most closely with the third specimen.

Thus we see that the general tendency in this species is towards an upward bushy growth, but in the largest and most complete specimen (Plate VI. fig. 1) the twigs were directed mainly towards one aspect.

Another remarkable feature of the most perfect specimen is that *there is no hint of attachment*. The basal portion is very thick and has evidently been broken from its support, but it is now completely overgrown by the coenenchyma. This secondary growth is to be seen in the case of another branch in this specimen, and is not of infrequent occurrence in several of the others. May not this circumstance, to

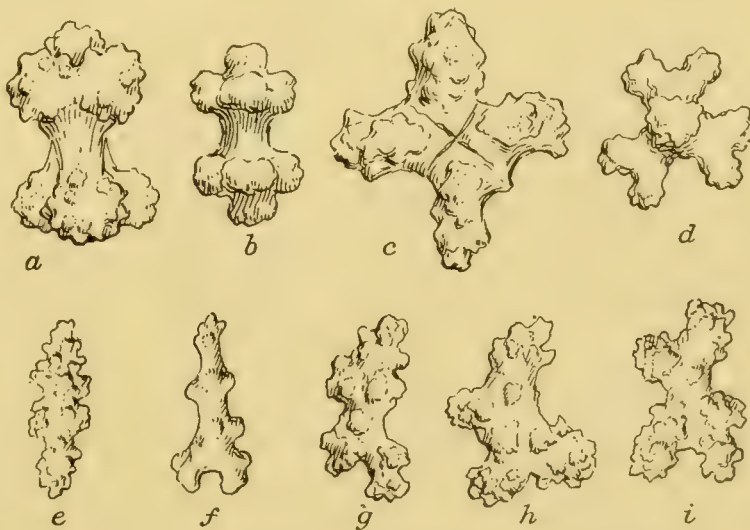


Fig. 77. Spicules from coenenchyma of *Isis hippuris*.

a great extent, explain the unilateral direction of the growing points of the branches in this specimen, as contrasted with the typical form in the others? Having become detached from its support, and with a tendency to lie horizontally, the colony would produce branches towards the upwardly directed surface. It seems to us that this consideration is worthy of attention in

reference to other plastic colonies whose contour is subject to great modification through position, the agency of currents and the like. It leads one to recognise that the general shape of a colony affords but a slender basis on which to raise a superstructure of classification.

The axis (fig. 1) consists of white calcareous internodes and brown horny nodes. The internodes are symmetrically sculptured, ridges and furrows alternating around the whole circumference. The ridges appear smooth to the naked eye, but when slightly magnified present a beautifully serrated edge. They vary in number in the different parts of the colony, there being fewer in the younger portions. Twelve, thirteen and fourteen are common on the larger branches. In the older parts of the colony the internodes are almost cylindrical, but on the primary and secondary branches they are slightly narrower at the middle, while in the twigs they are torpedo-shaped. The nodes resemble fish-vertebræ in form. They are short and markedly constricted, and have a silky lustre. At the ends they are slightly ridged, conforming to the contour of the internodes; but this gradually diminishes, so that at the centre they are perfectly smooth. They contain no calcareous matter, except near the base, where a central limy rod connects them with the internodes. In mass they appear dark brown, but in section the colour is golden-yellow.

The nodes and internodes vary in length throughout the colonies so that no general size can be stated as typical. The following measurements of a node and its adjacent internode were taken at different parts:—

(a) Main stem:—

Internode 4·5 mm. in length and 7 mm. in diameter.

Node 3 „ „ 6 „ „

(b) Branch:—

Internode 6 mm. in length and 3 mm. in diameter.

Node 6 „ „ 1·5 „ „

The branches arise from the calcareous internodes, generally one from each, but as many as three sometimes occur on one internode. In most cases there is a considerable calcareous portion before the first node; but this is often so reduced that the branches seem to arise with a horny part. In other places, owing to the origin being close to the node, the branch seems to arise from it.

Cross and longitudinal sections of a calcareous part, 1 cm. in diameter, were ground to show the internal structure. There is a distinct radiate appearance from centre to periphery. About 1·2 mm. from the centre there is an undulating line which corresponds to the grooves on the outside, but in this case they are fewer in number. Towards the circumference, and at a distance similar to the first, there is another almost identical line with a greater number of undulations, but still fewer than those on the periphery. These wavy lines doubtless correspond to what were previously the external surfaces of the axis.

The central portion is quite homogeneous in character and is apparently amorphous; but in the younger part it is evidently composite, the small particles giving different extinctions. It cannot be argued from this, however, that the axis is sclerogorgic, because the boundary-lines of the different parts may be the organic remains of the dead calicoblasts. At the same time, it is important to note that in similar sections of *Melitodes* little or no difference could be found. This subject is worthy of further study, seeing that it is used as a basis of classification. When the internodes were decalcified, there was a considerable residue of organic matter.

The cœnenchyma is very thick (Plate VI. fig. 2), in some parts 2·5 mm. It is supported by small, densely packed spicules of various shapes, which make it very brittle; and hence the markedly deciduous character, so often referred to. On the surface there is a layer of spicules arranged so that all their warty ends project outwards, and form a specially hard protective layer. Owing to the enormous preponderance of spicules, it was almost impossible to cut sections. Decalcification resulted in a complete collapse of the cœnenchyma.

The nutritive system consists of (1) a longitudinally arranged set of canals, one corresponding to each groove on the axis; (2) a branching system throughout the cœnenchyma connecting these with the individual polyps. The main canals have soft flaccid walls, are circular in section, and have a diameter in some cases of about 1 mm.

The polyps (Plate VI. fig. 3) are scattered over the whole cœnenchyma at intervals of 0·5 to 0·1 mm. There are no verrucæ, so that when the anthocodæ are withdrawn the surface presents a dotted appearance. Round each of the openings the spicules are grouped in eight bundles, and so form a stellate figure. The expanded polyp has a length of 1·25 mm.

The tentacles are 0·5 mm. in length, with a diameter of 0·5 mm. at their base. They are flat and lanceolate, and bear a single row of short, thick, cylindrical pinnules. They are first infolded so as to form a somewhat elongated cone, and then the whole is withdrawn within the level of the cœnenchyma. The polyp-cavities (Plate VI. fig. 2) are vase-shaped, and have a depth of 1·25 mm., with a maximum diameter of similar dimensions.

In some of the specimens under consideration reproductive bodies of enormous size are present. These are situated either singly or in pairs, though in some cases three are to be found. They have a diameter of about 1 mm., and are apparently in an advanced stage of development. They are of the same colour as the general cœnenchyma and present a glistening appearance.

The spicules are very diverse in character. The following are some of the more prominent types, with measurements of length and breadth in millimetres:—

(a) *Coenenchyma*: (1) Rods with at each end a whorl of three large papillose warts, 0.2×0.1 ; 0.2×0.15 .

(2) Tri- and quadri-radiate forms, 0.1×0.1 ; 0.125×0.125 .

(3) Stellate forms with warty knobs, 0.1×0.1 ; 0.075×0.075 .

(4) Short rods with large warty knobs irregularly arranged, 0.2×0.125 ; 0.15×0.1 .

(5) Irregular and intermediate forms, 0.2×0.1 ; 0.07×0.07 .

(b) *Anthocodiae*—Similar forms, but slightly smaller.

(c) Tentacles—Stout rough clubs with short handles, warty at the end, 0.055×0.045 , and 0.2 at the narrow smooth part.

Locality: Andaman Sea, 20 fathoms; also surf-line.

Previously recorded from Pacific Ocean (Wright and Studer); Indian Ocean (Ellis), (Pallas); Mediterranean Sea (Pallas); America (Pallas); North Sea (Linnæus); Iceland (Olafsen and Polvesen), (Lamouroux); Antilles and United States (Lamouroux); Straits of Sunda and Southern Coast of Sumatra (Ellis); East Indies (Dana); Amboina (Milne-Edwards and Haime).

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Family *MURICEIDÆ*.

- Acanthogorgia muricata*, Verrill.
Anthogorgia glomerata, n. sp.
 „ *racemosa*, n. sp.
Calicogorgia investigatoris, Thomson and Henderson.
 „ *tenuis*, n. sp.
Echinomuricea uliginosa, n. sp.
 „ *andamanensis*, n. sp.
 „ *indica*, n. sp.
 „ *ochracea*, n. sp.
 „ *reticulata*, n. sp.
 „ *splendens*, n. sp.
Echinogorgia flabellum, Esper.
 „ *pseudosassapo*, Kölliker.
 „ *ramulosa*, Gray.
 „ *intermedia*, Studer.
 „ *multispinosa*, Thomson and Henderson.
 „ *macrospiculata*, n. sp.
 „ *flexilis*, n. sp.
Menacella gracilis, n. sp.
Bebryce mollis, de Philippi.
 „ *tenuis*, n. sp.
Acamptogorgia bebrycoides, G. von Koch.
 „ *rubra*, Thomson.
 „ *ceylonensis*, Thomson and Henderson.
 „ *tenuis*, n. sp.
Acis ceylonensis, Thomson and Henderson.
 „ *indica*, Thomson and Henderson.
 „ *pustulata*, Wright and Studer.
 „ *ulex*, n. sp.
 „ *rigida*, n. sp.

- Elasmogorgia filiformis*, Wright and Studer.
 „ *flexilis*, Hickson.
Muricella complanata, Wright and Studer.
 „ *ramosa*, Thomson and Henderson.
 „ *rubra*, Thomson.
 „ „ var. *robusta*, n.
 „ *arborea*, n. sp.
 „ *robusta*, n. sp.
Eumuricea splendens, n. sp.
 „ *ramosa*, n. sp.

GENUS ACANTHOGORGIA, Gray.

Acanthogorgia muricata, Verrill.

A. muricata, Verrill, "Bull. Mus. Comp. Zool. Harvard Coll.," vol. ii. No. 1, p. 34. Cambridge, 1883.

A. muricata, Hiles, "Gorgonacea from Funafuti," "Proc. Zool. Soc.," p. 48. London, 1899.

A. muricata, Studer, "Alcyonaires provenant des Campagnes de l'Hirondelle," fasc. xx. (1901), p. 45.

A. spinosa, Hiles, "Willey's Zoological Results," Part II. p. 198. Cambridge, 1899.

A. aspera, Pourtales.

Belonging to this genus so prolific of species there are in the collection a great number of specimens from five different localities. In the Report on the "Investigator" Deep-sea Alcyonarians a comparative table is given, and even a cursory glance at this suggests that many of the characters on which new species have been formed are of doubtful significance. As we have elsewhere noted habitat plays a very important part in the moulding of general contour, and in the genus *Acanthogorgia* this must not be overlooked, in fact the architecture of the verrucæ and polyps seems to be the character of greatest specific moment. Too fine distinctions, however, must not be drawn, for in one and the same colony there is often considerable difference. Such characters as the transverse rows of spicules near the apex of the verrucæ in *A. horrida*, Studer, and the cup-shaped verrucæ with long peduncle in *A. longiflora*, Wright and Studer, are obviously distinctive, but the mode of grouping and the number of spicules in the clusters at the apex of the verrucæ are difficult to determine, so that too great stress must not be placed on this as a specific character. In one specimen which we studied we found in the more expanded polyps as many as five spines projecting in each of the eight bundles. Some of these were arranged radially so that when the polyp was further withdrawn those nearest the centre became almost horizontal, and the number was consequently diminished until in some cases

only one spine remained in the vertical position. Again, owing to the extremely spinose character of the verrucæ these suffer considerable damage by fracture and detrition, in fact it is hardly possible to get a preserved specimen with anything like a high percentage of perfect verrucæ.

The specimens from Funafuti, on which Miss Hiles established the species *A. spinosa*, differed from *A. muricata*, Verrill, *only* in the fact that in the former there were eight projecting groups of two or three spicules while in the latter there were eight single spicules. From a study of the large number of specimens in this collection we feel that this subtle distinction cannot be considered valid, and therefore suggest the merging of *A. spinosa* into *A. muricata*. Moreover, the differences between *A. aspera*, Pourtales, and *A. spinosa*, Hiles, are so very slight, that we think *A. muricata* should include the two others.

We may give here a few macroscopic details which superficially would seem to separate the specimens from the different localities; in the architecture of the polyps, taking into account the modification due to contraction already cited, all agree very well with the description given by Verrill and also with that given by Miss Hiles for *A. spinosa*.

A. Several very robust specimens, the largest of which is 110 mm. high and 100 mm. broad, branched in one plane. The branching is so profuse that many of the twigs seem to arise at right angles to the plane of ramification and give the whole a bushy appearance. The cœnenchyma is fairly thick and the verrucæ are crowded over the whole of the stem and branches, touching basally; all stages of growth are intermingled with the more mature forms, which are about 3 mm. high and 1.25 mm. in diameter. The axis is thin, horny, flexible and spirally twisted in the older portions. Colour—pale chocolate-brown.

B. Typical colony 55 mm. high and 45 mm. broad. Cœnenchyma thick and very rugose. Verrucæ occur all round but are more crowded towards the tips of the twigs. They are short and thick, about 2.25 mm. in height and 1.25 mm. in breadth. Colour—chocolate-brown.

C. Colony 55 mm. in height and 45 mm. in breadth, laxly branched in one plane; verrucæ arise all round but at considerable intervals, except in the twigs where they are crowded. Cœnenchyma thin and transparent, almost yellow in colour.

D. Laxly branched in one plane; branches slender; cœnenchyma thin, brown in colour; verrucæ occur on all parts, scattered, 3 mm. high, 1 mm. in diameter at base, and 1.25 mm. in diameter at apex.

E. Numerous specimens very like D but with more crowded verrucæ.

F. A great number of specimens about 60 mm. high and 45 mm. in breadth; cœnenchyma thin and not rugose; verrucæ—some cylindrical, others much expanded at apex; the arrangement of the spicules on the verrucæ varies

greatly as to regularity in eight rows and also as to degree of projection; the cylindrical forms are about 3 mm. high and 1.25 mm. in diameter, the others are about 3.5 mm. high, 1.25 mm. in basal diameter, and 1.5 mm. in apical diameter.

G. A number of colonies laxly branched in one plane; coenenchyma moderately thick; verrucae elongated, slender and expanded at the apex, 3.5 mm. high, 1 mm. in basal diameter, and 1.5 mm. in apical diameter; they occur thickly but are not crowded. Colour—pale brown.

Localities: A—Marble Rocks, Mergui; B—off Malabar Coast, 31 fathoms; C—Andamans; D—off Cape Comorin, 38 fathoms; E—off Gopalpur, Coromandel Coast, 14-15 fathoms; F—off Malabar Coast, 36 fathoms.

Previously recorded from: Barbadoes (Verrill), Azores (Studer), Funafuti (Hiles), Blanche Bay, New Britain (if = *A. spinosa*, Hiles).

GENUS ANTHOGORGIA, VERRILL.

This genus was established by Verrill to include a colony which previously he had referred to *Muricea*. Thus *Anthogorgia divaricata*, Verrill ("Amer. Jour. of Science and Art," vol. xlv. p. 412, 1868) = *Muricea divaricata*, Verrill ("Proc. Essex Inst.," vol. iv. p. 188, Pl. V. figs. 5 and 6, 1865). The following is his diagnosis of the genus: *Anthogorgia*—characterised by *very prominent tubular cells, eight-rayed at the summit*; thin coenenchyma containing embedded fusiform spicula, those of the cells long, fusiform, thorny, imbedded at various angles in the surface but not imbricated.

Wright and Studer in the "Challenger" Report, vol. xxxi. p. liii., give the following diagnosis: Colony is branched with slender elongated branches. The polyp calyces are strongly projected, of a tubular form, with an eight-rayed operculum *consisting* of a thin ectoderm in which large long spindles are embedded at various angles. The coenenchyma is thin with large warty spindles.

The following species are known and described:—

A. divaricata, Verrill, "Proc. Essex Inst.," vol. iv. p. 188; from W. Australia and Hong Kong.

A. verrilli, Thomson and Henderson; from the Andamans, 270-45 fms.

In the Supplement to the "Challenger" Report (1889, p. 12), Studer described a specimen under the name of *Anthogorgia japonica*, but as the operculum is *tentacular* and not *calycine* it must be excluded from this genus.

Anthogorgia glomerata, n. sp. Plate II, fig. 8; Plate III. fig. 11.

This species is represented by a very ragged fragment of a remarkable colony. It is branched in one plane and anastomoses freely; it measures 6 cm.

in height and 9 cm. at the broadest part. It consists of short portions of two main branches 3.5 cm. apart. One of these is bent and is 4 cm. long; the other measures 1.5 cm. in length. The latter gives off a branch almost perpendicularly which diverges so as to meet a corresponding branch from the other main part and fuses with it. In one place three branches fuse together at a common point forming a six-rayed star with three free ends. The twigs arise mostly at a large angle. The thickest branch is flattened perpendicular to the plane of ramification, being elliptical in section, the major and minor axes measuring 4 mm. and 2.5 mm. respectively.

The coenenchyma is thin, especially on the larger branches, so that the axis appears through it. It is very rough, being composed of warty spindles arranged in all directions. These are sometimes grouped together to form ridges which often wind about and interlace.

The disposition of the verrucae is very characteristic. On the larger branches they are irregularly arranged all over the coenenchyma, but at the origin of the branchlets there is a space devoid of polyps, and a similar part often extends for 4 mm. on the twig itself. Beyond this, clusters of polyps disposed all round and naked spaces of about equal length occur alternately. A bare space also occurs at the points of fusion of the branches. Sometimes a linear bare tract can be discerned among the clusters; this always occurs at the end of the major axis of the cross section, but not invariably, on one side of the expanded colony. The polyps are very prominent, and are 0.75 mm. in height and 1.25 mm. in diameter. The operculum is formed from the top of the verruca and consists of eight triangles which meet and close over the retracted anthocodia. On the aboral surface of the tentacles a few small spicules occur.

The axis is horny, black in colour in the older branches, but fading to pale brown in the twigs. It is very compact and has a small whitish core. It is flattened in the lower portions, but in the twigs it retains its cylindrical form.

The colour is creamy-white, but the black axis shines through in the older parts.

The spicules are spindles covered with tuberculated or branching warts. They are straight, slightly curved or twisted, and have the following range of measurements, length by breadth in millimetres:—

0.7 × 0.3; 0.6 × 0.1; 0.6 × 0.05; 0.5 × 0.15; 0.5 × 0.1; 0.25 × 0.02; 0.2 × 0.015.

Locality: Andamans.

Anthogorgia racemosa, n. sp. Plate II. figs. 2 and 3; Plate VIII. fig. 14.

To this species we refer a number of slightly damaged specimens. The largest of these is 110 mm. in height and 80 mm. in breadth. The branching is confined to one plane; the branches arise very indefinitely and are markedly

sinuous. There is no hint of anastomosis. The axis is horny and dark brown at the base, but becomes almost pale yellow in the twigs. The diameter of the main stem is over 4 mm., that of the twigs about 1 mm. The coenenchyma is thin and allows the axis to shine through. It is densely covered by an armature of warty spindles which are easily rubbed off.

On the main stem and larger branches the polyps occur all round at considerable intervals, but on the twigs they are disposed mainly on the lateral surfaces. When expanded the verrucae are cylindrical and are about 3 mm. in height and 1 mm. in diameter; they are capable of retraction to a height of 1 mm. On the verrucae the spicules overlap and form a network which is surmounted by eight triangular teeth, each composed of two spicules enclosing an acute angle. Abundant spicules are found on the aboral surface of the tentacles.

The spicules are predominantly spindles. The following are some of the measurements length by breadth in millimetres:—

- (a) Coenenchyma: Warty spindles, 0.9×0.2 ; 0.8×0.15 ; 0.6×0.1 ;
 0.4×0.08 .
- (b) Tentacles: Spiny spindles, 0.4×0.025 ; 0.3×0.03 ; 0.2×0.025 ;
 0.2×0.015 .

Another specimen in the Wood-Mason Collection is 150 mm. in height and 90 mm. in maximum breadth. The basal attachment is conical and much expanded. The branching is in one plane and anastomosis does not occur. The stem is 2 mm. in diameter at the base and the main branches are about the same. The height of the verrucae is from 2-2.5 mm. The colour of the verrucae is creamy-white, that of the axis yellowish. This species may be distinguished from *A. verrilli*, Thomson and Henderson, in the following respects: (1) The whole colony is more robust; (2) the branching is more profuse and more strictly in one plane; (3) the coenenchyma is thicker and more rugose; (4) the polyps are more numerous; (5) the spicules are shorter and thicker; (6) the spicules on the tentacles are longer.

From *A. glomerata* it differs markedly in the disposition of the verrucae.

Locality: Andamans.

GENUS CALICOGORGIA, Thomson and Henderson.

Calicogorgia investigatoris, Thomson and Henderson.

To this species we refer a magnificent colony 235 mm. in height and 205 mm. in maximum breadth. It consists of a main stem arising from a conically expanded base from which large branches are given off on either side; these again ramify in the same plane. The verrucae are truncated cones slightly compressed, having a basal diameter of over 2 mm. and an average height of 3 mm., the dome-like anthocodiae standing on the top to a height of 1.5 mm. They

are disposed mostly on the two lateral surfaces, but in some parts occur all round.

The general colour of the cœnenchyma is pinkish-yellow ; the verrucæ are pale yellow.

The spicules of the verrucæ are warty and spiny spindles, but a few crosses occur. The spindles vary in length from 1·8 mm. to 0·1 mm.

The spicules of the cœnenchyma are not so large, but are of the same types.

Locality : Gulf of Martaban ; 67 fathoms.

Previously recorded from "Investigator" Station 246 ; 11° 14' 30" N., 74° 57' 15" E. ; 68-148 fathoms.

Calicogorgia tenuis, n. sp. Plate III. fig. 10.

A small complete colony of a creamy-white colour branching irregularly in one plane ; it is 60 mm. in height and 65 mm. in maximum breadth. The branches show no definite arrangement, nor does the angle of origin appear constant. In one place anastomosis has occurred.

The axis is of a light brown colour. In the older parts it is comparatively rigid with a diameter of 2·5 mm., but in the smaller twigs it is soft and collapsible and tapers to a fine point.

The cœnenchyma is thin and allows the pale axis to appear through the transparent spicules. In one place where a cirripede gall is attached the cœnenchyma has quite overgrown it. The spicules in the cœnenchyma are disposed for the most part longitudinally, but the interlocking is very varied.

The polyps are disposed irregularly on two sides and the twigs terminate with a pair at slightly different levels. The verrucæ are small and wart-like. The spicules are arranged longitudinally, and there is a distinct hint of grouping into eight sheaves which give a serrate margin to the aperture. The anthocodæ are proportionately large and are completely retractile. They are abundantly supplied with spicules, and the arrangement of these recalls the Siphonogorgid crown and points. This feature, however, is not very definite, so that all one can say is that there are eight longitudinal groups of spicules surmounting an indefinite circumferential aggregate. The spicules are continued into the tentacles on the aboral side and even along the pinnules where they are arranged in inverted V's. When the anthocodæ are partially retracted the tentacles are infolded and surmount the contracted verruca in the form of an expanded dome.

The following are the types of spicules with some measurements, length by breadth, in millimetres :—

- (a) Coenenchyma : (1) Colourless spiny or warty spindles mostly straight, but curved or S-shaped forms occur : 1.2×0.15 ; 1.0×0.2 ; 0.8×0.1 .
 (2) Spindles very thick in the middle but tapering markedly to both ends : 0.8×0.2 ; 0.75×0.2 .
 (b) Anthocodiae : Spiny spindles : 0.5×0.05 ; 0.4×0.05 .
 (c) Tentacles : Spiny spindles : 0.24×0.025 ; 0.2×0.02 ; 0.1×0.015 .
 Locality : Andamans.

GENUS ECHINOMURICEA, Verrill.

The type of this genus is *E. coccinea*, Verrill (= *Acanthogorgia coccinea*, Verrill, "Proc. Essex Inst.," iv. p. 188. Plate VI, fig. 7) (and *Nephthya coccinea*, Stimpson), and was established by Verrill in "Amer. Jour. of Sci. and Art," 2nd ser. vol. xlvii. p. 285, 1869.

Wright and Studer ("Challenger' Reports," vol. xxxi. p. liv.) thus define the genus: Colony is simple or branched; the stem and branches are thickly beset with polyp calyces. These are short, cylindrical or conical, truncated terminally and with horizontally disposed tentacular opercula. The calyces are covered with spicules of a peculiar form, overlapping one another; these consist of long flat needles which give off several root-like processes from their expanded ends. The apices of the needles project.

Hedlund accepts this diagnosis, but adds that "the operculum at the base of each tentacle is a group of two rows of more or less delicate needles converging. *There is no collaret.*" This, he says, distinguishes *Echinomuricea* from *Paramuricea*. It must, however, be noted that although this may hold in *E. peterseni*, Hedlund, and *E. coronalis*, Germanos, it certainly does not obtain in *E. uliginosa*, n. sp., *E. andamanensis*, n. sp., *E. indica*, n. sp., and *E. reticulata*, n. sp., though in the latter to a less marked degree. Yet we have little or no hesitation in placing these in the genus *Echinomuricea*.

Again in the generic diagnosis quoted, Wright and Studer refer to a "horizontally disposed tentacular operculum," but in *E. uliginosa*, n. sp., the operculum is elevated and conical. This divergence may, however, be the result of different degrees of retraction.

Wright and Studer refer to a specimen which they place in a species established by Ridley, *viz.*, *E. indomalaccensis*, but we concur with Hedlund's opinion that among other things the form of the verrucæ would point to closer affinities with *E. philippinensis*.

Hedlund thus classifies the species established up to the time of the publication of his memoir:—

The spines of the verrucae.	Sharply toothed.	Verrucae wart-like.		<i>E. coccinea</i> , Stimp- son.
	Smooth.	Verrucae	Shorter than broad wart-like. Twigs thicker at tip.	<i>E. indomalaccensis</i> , Ridley.
			Not shorter than broad.	<i>E. philippinensis</i> , Hedlund. (= <i>E. indomalac-</i> <i>censis</i> , Wright and Studer.)
				<i>E. peterseni</i> , Hed- lund.
			Cylindrical. Twigs thicker at tip.	
			Expanded above. Twigs uniformly thick.	

Summary of Previously Described Species of Echinomuricea.

The genus *Echinomuricea* is closely related to *Paramuricea*, but may be usefully distinguished by the characteristic form of verruca spicule, namely, a long slender shaft, smooth or tuberculate, springing from a very divaricate basal portion. The genus is also closely related to *Acamptogorgia*, but may be distinguished by the characteristic spicules just referred to, and by the fact that the rough surface of *Acamptogorgia* is due to projecting folia, whereas in *Echinomuricea* it is due to projecting single spines. There seems no doubt, however, that *Paramuricea*, *Acamptogorgia* and *Echinomuricea* are nearly related genera. Between *Acanthogorgia* and *Echinomuricea* there is a resemblance in the possession of spicules, with a long spine rising from a divaricate base, but the architecture of the verrucae is quite different in the two genera. The species *Acanthogorgia grayi*, Johnson, and *A. atlantica*, Johnson, which Ridley referred to *Echinomuricea*, were rightly referred by Verrill to *Paramuricea*. In reality, *Acanthogorgia* and *Echinomuricea* are somewhat far apart.

Echinomuricea indomalaccensis, Ridley, "Zool. Report on the Collections of H.M.S. 'Alert,'" p. 336. Plate XXXVI. figs. B and B'; Plate XXXVIII. figs. d to d'''. Thomson and Henderson, "Ceylon Pearl Oyster Report," p. 291.

Colony erect, branched almost exclusively in one plane, at angles of about 75°. Branches cylindrical, slightly clavate. Axis very tough and flexible, very dark brown at the base, paler in the branches. Cortex thin, red, arenaceous in appearance. Verrucae crowded over all parts of the cortex leaving but small intervals, prominent but truncate, resembling low turrets; the rim is beset with scattered spine-like spicules with branched bases, about two-deep; the points project directly upwards in the expanded state. Spicules: Cortex (1) Conical, with rounded broad end tapering to a moderately sharp smaller end, the whole thickly covered with very coarse blunt tubercles, 0.32 mm. to 0.35 mm. by 0.123 mm. to 0.177 mm. (2) Conical to fusiform with prominent divaricate tubercles

0·38 mm. by 0·1 mm. to 0·14 mm. (3) Tri- and quadri-radiate forms 0·53 mm. \times 0·07 mm. to 0·14 mm. Verrucae spicules with expanded ramifying basal portion—*spine smooth*, length 0·35 to 0·65 mm., breadth 0·177 to 0·46 mm., spine 0·25 to 0·37 mm. by 0·053 to 0·087 mm. Anthocodiae: curved fusiform spicules with smooth ends.

Localities: Port Curtis, Queensland, 5-11 fathoms; Port Molle, Queensland, 12-20 fathoms; Warrior Reef, Torres Straits.

Specimens from the Gulf of Manaar reveal the following differences:—

(1) Verrucae are twice as long as in the type specimen.

(2) The verrucae spicules with ramifying basal portion vary from 0·7 mm. to 0·9 mm. in length.

Echinomuricea philippinensis, Hedlund = *E. indomalaccensis*, Wright and Studer, “‘Challenger’ Report,” vol. xxxi. p. 112. Plate XXIII. fig. 4; Plate XXVII. fig. 3.

Branched in one plane, anastomosing. Coenenchyma thick, ends of branches club-like. Polyps crowded all round the periphery at right angles to the stem. Calyces cylindrical truncated, opercular region does not project. Polyps 0·8 to 1 mm. in diameter. The spicules of the coenenchyma are either (1) simple spindles straight or curved with tubercles which are often branched, or (2) spindles with lateral branched prominences. The spicules of the calyx are pointed spindles with expanded basal portions which give off several (2-6) downwardly directed lobes, provided with simple or complex spines. The opercular coverings are composed of thin fusiform spicules placed on the basal portion of each tentacle. Colour—dark red.

Locality: Panay, Philippines; 20 fathoms.

E. peterseni, Hedlund, “Bihang K. Svensk. Vet. Akad.,” Bd. xvi. No. 6.
Plate III.

Colony slightly branched; branches of uniform thickness. Verrucae cover the cortex, higher than broad, expanded “orally”. Polyps arise vertically, close together; the upper part of the verrucae is provided with numerous projecting spines, the upper bent over the mouth almost closing it. The tentacular operculum is quite withdrawn. Axis horny, flexible, brown. The cortex is thick with a coarse granular surface under the lens. The spicules are red, heterogeneous spindles, clubs, stars and other irregular forms. The spindles are strongly warted, straight or curved, often with longer or shorter warty processes at one or both ends. Larger spindles are 0·65 mm. \times 0·09 mm. to 0·15 mm.; warty knobbed clubs sometimes apparently stellate at one end; most abundant are 3-5 rayed warty stars; irregular perforated plates in calyces

slightly imbricated. In the upper part of the calyx the spicules have the form characteristic of the genus, *viz.*, a needle-shaped shaft springing from a divaricate portion, the basal part having 2-6 warty processes, the spine part *smooth*. At the base of each of the tentacles there are two rows of slender warty needles, including acute angles at the distal extremity. *There is no collaret.*

Locality : Hong Kong.

E. coronalis, Germanos, "Gorgonaceen von Ternate," "Abh. Senck. Nat. Ges.," xxiii. heft 1, p. 165, Plate X. figs 9, 10.

Colony bush-like, twig ends usually club-shaped. Coenenchyma thick, especially on the twigs, bearing, superficially, large much curved spicules with long processes. Beneath these there are similar smaller spicules. Verrucae hardly projecting, opening surrounded by a wreath of long smooth spines on an expanded ragged basis. The spicules of the coenenchyma form two not very definite layers. In those of the upper layer very strong thorny processes spring from about the middle of large spindles which often acquire a 3- or 4-rayed or irregular T-like appearance, as if two were joined by their convexities. The spicules of the inner layer are much smaller. At the free end of the verrucae there are long, vertical, projecting needles; a second ring more irregular and more divergent is found lower down; these sit upon an expanded basal part which bears small warts. The operculum consists of small, straight or slightly curved rods and spindles which lie more or less obliquely in two rows, one on each side of the middle line of the dorsal surface of each tentacle; the tips of the triangles thus formed usually reach to the middle of the tentacles. *There is no collaret.*

Locality : Ternate.

Note.—This species comes nearest to *E. indomalaccensis*, Ridley, but is distinguished not only by its brownish-red colour but also by the arrangement of the spicules, by the shape of the verrucae which are not only *not* stalked but hardly protrude, by the mode of branching which is generally dichotomous at the end, and by the form and arrangement of the coenenchymal spicules.

Correction.—The specimen described as *Echinomuricea ceylonensis* (Thomson and Henderson, "Ceylon Pearl Oyster Fisheries Report," p. 292. Plate VI. fig. 6), should have been referred to the genus *Acamptogorgia*. The two genera are closely allied, but as we have indicated above each has its distinctive spiculation.

Species of Echinomuricea in this Collection.

Echinomuricea uliginosa, n. sp. Plate IV. figs. 6 and 7.

This species is represented by a colony of a pinkish-red colour branched in one plane. It measures 19 cm. in height and about 5 cm. in breadth. It con-

sists of a main stem, 19 cm. long and 4.5 mm. in diameter, from which two branches arise, one on either side. The lower branch is 9 cm. long and arises at an acute angle. The upper, which is incomplete, measures 4.5 cm. in length. The diameter of the branches is about the same as that of the main stem and is almost uniform throughout their entire length.

The cœnenchyma is thick and very rugose in appearance, being supported by spicules arranged in all directions.

The polyps are disposed closely over the whole surface so that very little of the cœnenchyma is seen. The verrucæ are large, measuring 1 mm. in height and 1.5 mm. in diameter. The surface is covered by the long smooth projections of the spicules, the spiny part being noticeable further down. These projections are directed upwards and outwards and are sometimes curved. They are often disposed in whorls, but at other places are irregularly arranged and give the polyps a very spiny armature. The anthocodiæ are completely retractile. There is a long œsophageal portion, often extending to a length of 2 mm., of a dark brown colour. The greater number of these are protruded and give the colony a characteristic appearance. There is an elevated conical operculum composed of eight groups of three spindles and a collaret of two or three rows of transversely arranged curved spicules. The "points" consist of two bent spindles which touch for over three-quarters of their length but diverge near the collaret, the interspace being almost completely filled by a short, curved, transversely disposed spindle.

The axis is brown and cylindrical. It is divided into chambers by tranverse septa. The lower portion is firm and flexible, but the upper part is soft and collapsible. It is composed of long strands and when cut longitudinally these strands appear alternately light and dark, giving a peculiarly bright sheen. It is horny in composition and measures 1.75 mm. in diameter at the base.

The spicules of the cœnenchyma are very characteristic—especially those which show a number of smooth spines projecting from one side of a warty spindle. The following are some of the chief types with measurements in millimetres :—

(a) One smooth spine from the base of which project a number of branching arms irregularly covered with warts :—

0.55 × 0.35, spine 0.3 long and 0.075 broad at base.

0.7 × 0.3, „ 0.4 „ „ 0.08 „ „ „

0.6 × 0.3, „ 0.4 „ „ 0.1 „ „ „

0.7 × 0.6, „ 0.4 „ „ 0.1 „ „ „

(b) Bent thick spindles with irregular warts, 0.6 × 0.2; 0.8 × 0.12.

(c) Spindle-shaped spicules covered with warts but giving off on one side a number of smooth projecting spines.

Spindle part 0.6×0.2 , spines 0.3 long giving in all 0.6×0.5 .

„ „ 0.6×0.22 , „ 0.275 „ „ „ 0.6×0.495 .

„ „ 0.6×0.2 , „ 0.38 „ „ „ 0.6×0.58 .

(*d*) Irregular forms with warted branches on one side, smooth spines on the other, 0.6×0.5 ; 0.6×0.48 , *i.e.*, inclusive of spines.

(*e*) Warty spindles, 0.6×0.1 .

(*f*) Spindles bifurcated at both ends, 0.6 long, 0.18 in thickness and 0.25 between the terminal points.

(*g*) Irregular plates with warty branches, 0.6×0.3 .

(*h*) Smooth spindles of the anthocodæ, 0.5×0.03 ; 0.52×0.03 ; 0.46×0.02 .

Locality: Kalpeni Bank, Laccadives. Marine Survey.

Another fragmentary specimen is recorded from Arakan Coast; 13 fathoms.

Echinomuricea andamanensis, n. sp.

Plate I. fig. 8; Plate VIII. fig. 2.

A complete colony of a brown colour growing on a piece of rock covered with Polyzoa; it is 90 mm. in height and 80 mm. in maximum diameter. The branching is in one plane. At a short distance from the base the main stem bifurcates; the subsidiary stems ascend almost vertically, but are joined at two points by fusion with secondary branches. The branching is quite irregular, but nearly all the branches arise almost perpendicularly; many keep their original course but others curve and twist in the interspaces. Fusion however is not infrequent.

The axis is horny and comparatively hard though flexible; the surface has a bright sheen of a dark bronze colour.

The cœnenchyma is fairly thick so that the branches have an almost uniform diameter throughout, except at the tips which are swollen and club-shaped. The surface has a glistening arenaceous appearance.

The polyps are disposed irregularly over the whole cœnenchyma but in some places an almost spiral arrangement is discernible. The verrucæ are not prominent but give the surface an undulating contour. They are more spinose than the cœnenchyma, and around the aperture there is an indefinite serrate margin. The anthocodæ are almost completely retractile but show a distinct octo-radiate horizontal operculum. This consists of a collaret of about three rows of curved spindles surmounted by eight triangles each composed of five spicules. Four of these are arranged "en chevron" enclosing an acute angle, while the fifth, which is considerably smaller, fills the basal interspace. The spicules are colourless. The following are the more prominent types with measurements, length by breadth, in millimetres:—

Coenenchyma : (1) A thick conical *rugose* spine from one end of which warty projections arise. The latter vary much in shape and direction and are often branched.

Total length,	0.5	0.4	0.35
Total breadth,	0.25	0.25	0.25
Length of spine,	0.2	0.2	0.15
Breadth of spine,	0.1	0.1	0.1

These pass by gradual transitions to

(2) Very warty clubs, 0.4×0.25 ; 0.3×0.2 ; 0.25×0.15 .

(3) Irregular forms, 0.35×0.25 ; 0.3×0.25 ; 0.25×0.15 .

(4) Warty spindles, 0.8×0.2 ; 0.5×0.1 ; 0.4×0.05 ; 0.3×0.05 ; 0.2×0.03 .

Anthocodiae :—

Collaret : curved spiny spindles, 0.3×0.02 ; 0.25×0.02 .

Points : spindles, bent at the base like golf-clubs, 0.25×0.02 ; 0.2×0.02 .

Locality : Andamans.

Echinomuricea indica, n. sp.

Plate III. figs. 2 and 3 ; Plate VIII. fig. 4.

To this species we refer two small complete colonies each with a disc of attachment ; the largest is 65 mm. in height and 70 mm. in maximum breadth. They are both of a brown colour, but the larger is of a darker shade than the other. The branching is confined strictly to one plane, but owing to the sinuous nature of the branches the whole presents a characteristic appearance. The branches generally arise at right angles, and though maintaining their original direction curve and flex so as to be almost semicircular or S-shaped.

The axis is horny, slender and black ; the surface is very smooth and glistening.

The coenenchyma is moderately thick, and such that the diameter of the stem and branches is almost uniform throughout. It is of a dark brown colour, and when viewed with a lens presents a very spinose appearance, due to the projecting points of the typical tripod-like spicules.

The polyps are disposed over the whole surface, in some places apparently in spirals, but in others quite irregularly. The verrucæ are almost hemispherical with a diameter of 0.75 to 1 mm. They bristle with the points of projecting spicules which are directed upwards and outwards and form a very spinose armature. The anthocodiae are completely retractile. They are furnished with an elongated oesophageal region quite devoid of spicules. Surmounting this is a dome-like spiculose portion which forms the operculum. There is a distinct

collaret of 3-4 rows of curved spindles, and extending from this to the base of the tentacles are eight groups of spindles considerably bent at the proximal end. These are arranged in pairs or in groups of three. On contraction these do not all collapse at once. The tentacles are first infolded, and then one spicule from each point closes in over them; the others are directed upwards and outwards and with those around the top of the verrucæ present a very thorny appearance. On further contraction the remainder close upon the infolded tentacles and so form eight indistinct triangles. The whole anthocodia is then withdrawn until only the points project.

The spicules are all colourless: the following are the chief types with measurements in millimetres:—

Coenenchyma: (a) A *short, slightly toothed spine* from one end of which a pair of warty branches arise.

Length of spine,	0·4	0·3
Breadth of spine,	0·03	0·025
Total length,	0·45	0·35
Maximum breadth,	0·25	0·25

(b) Club-shaped forms consisting of an almost smooth conical shaft with 3-6 branching, very warty projections.

Total length,	0·5	0·5	0·4
Maximum breadth,	0·275	0·25	0·2
Length of shaft,	0·3	0·3	0·2
Breadth of shaft,	0·1	0·1	0·25

(c) Warty spindles, $0·4 \times 0·03$; $0·35 \times 0·03$.

Anthocodiæ—points: Spiny spindles bent like golf-clubs at one end, $0·3 \times 0·015$.

Anthocodiæ—crown: Spiny spindles curved almost uniformly; some are more spiny on the convex side, $0·45 \times 0·02$; $0·35 \times 0·02$.

Locality: Arakan Coast; 13 fathoms.

Echinomuricea ochracea, n. sp.

Belonging to the Wood-Mason Collection, is a delicate colony, branching in one plane. It is 100 mm. in height, and 120 mm. in breadth. Both the primary and secondary branches arise almost vertically, but gradually curve upwards. The branches are long, delicate and slender. Anastomoses occur in several places. The axis is very soft, and is almost black in colour. The coenenchyma is very thin, and in the older branches the axis is distinctly visible through it. The verrucæ are small and densely crowded, especially on the smaller branches; they are very spinose, the needle-like apices of the spicules projecting vertically, with no apparent arrangement, from the base to

the oral aperture. The following are the chief types of spicules: (1) Long, slender, curved, *spiny* needles; (2) Irregular forms; (3) Short, thick, smooth, conical needles, giving off root-like processes with rugose warts; the number of these varies considerably, very few exhibiting foliaceous expansions. The colour of the spicules is pale yellow. The colour of the specimen is also pale yellow, but the axis showing through makes it appear darker. This species belongs to the smooth-neededled section.

Echinomuricea reticulata, n. sp.

Plate I. fig. 9; Plate VIII. fig. 6.

Representing this species are two magnificent specimens measuring 200 mm. in length by 160 mm. in breadth, and 180 mm. in length by 110 mm. in breadth respectively. Both are branched in one plane and bear a disc of attachment.

In the larger colony the stem measures 2·5 mm. at the base and tapers gradually to 1·5 mm. near the tip. It is straight throughout its entire length and bears branches which arise perpendicularly at intervals varying from 3 mm. to 8 mm. The first pair, of which the lowest measures 140 mm. in length, are directed upwards, the remainder continuing in their original course. Secondary branches are given off in the same perpendicular manner. The diameter of the branches is almost uniform throughout. There is abundant anastomosis; the whole colony forms an open network with almost rectangular meshes. Some of the secondary branches extend almost as high as the main stem, generally anastomosing but sometimes simply overlapping.

The coenenchyma when viewed with a low power presents a very thorny appearance which is due to the projecting ends of long spicules. It is very thick, especially in the branches where it attains as much as 1 mm. The spicules are densely packed and give it a very gritty structure. The general colour is a light brown.

The axis is horny, thick near the base, but very slender and flexible in the branches. It is composed of interlocking strands and is very soft, presenting a ragged, glistening appearance. The colour is brown at the base but horny-yellow in the branches.

The polyps stand perpendicularly from the stem and branches and are disposed closely over the whole coenenchyma. The verrucæ are cylindrical, truncated terminally, and measure 0·5 mm. in height and 1 mm. in diameter. They are very spinose in appearance, the points of the spicules projecting upwards and outwards, imbricating but not overlapping, the topmost layer projecting beyond the circular opening. The great number of the verrucæ and the nature and method of arrangement of the spicules give the colony a char-

acteristically spinose appearance. The anthocodæ are almost completely retractile, but there is a definite, almost horizontal operculum. This consists of eight groups of long fusiform spicules arranged for the most part in parallel pairs, but sometimes two occur, forming an acute angle directed towards the distal ends of the tentacles and enclosing a single spindle. These extend to the base of the tentacles, and there is also a hint of a collaret of curved, elongated spindles.

The spicules of the coenenchyma and verrucæ are very characteristic, and though they seem diverse in form may yet be regarded as diverging from a common type. All consist of a smooth spine from the base of which two or more warty, simple or branching, arms arise. The following are the measurements in millimetres of the more common forms :—

- (1) 2 arms diverging in the same plane, 0.25×0.15 —spine, 0.15 ;
- (a) Sharp *smooth* spines with—
 - 0.25×0.2 —spine, 0.15.
 - (2) 3 projecting arms almost equal, 0.35×0.3 ; 0.4×0.31 .
 - (3) 3 unequal arms one again branching, 0.25×0.2 —smooth spine, 0.1.
 - (4) 4 projecting arms with 2 or more branched, 0.55×0.4 —smooth spine, 0.22.
 - (5) 5 projecting arms, 0.4×0.2 —smooth spine, 0.2 ; 0.35×0.2 —smooth spine, 0.18.
- (b) Tetra-radiate forms with an almost inconspicuous smooth nucleus, 0.35×0.35 .
- (c) Irregular clubs with numerous short warty arms, 0.6×0.4 ; 0.25×0.15 . Those of the anthocodæ and tentacles are slightly warty or spiny spindles. Anthocodæ : 0.7×0.05 ; 0.7×0.075 ; 0.45×0.05 . Tentacles : 0.15×0.02 ; 0.1×0.02 .

A young Pearl Oyster is attached to one of the branches of the smaller specimen, and there is a cirripede gall overgrown by polyp-bearing coenenchyma on the larger, which also bears a young crinoid.

Locality : Andamans.

Echinomuricea splendens, n. sp.

In the Wood-Mason Collection there are two small specimens of an *Echinomuricea* which seem to be new. The larger is 100 mm. in height, and 55 mm. in breadth ; the other is 90 mm. in height, and 55 mm. in breadth. The branching is in one plane, but no trace of anastomosis occurs. From an ascending main stem, lateral branches are given off almost perpendicularly. After a short distance, however, these curve upwards, and eventually run almost vertically. The secondary branches are given off in the same manner. The

axis is thin and soft; near the base it is brownish, but in the middle portions it is yellow and iridescent, while in the smaller twigs it is almost white. The coenenchyma is thick, especially in the younger branches, so that the branches are almost uniformly cylindrical, with a diameter of about 1.5 mm. The ends of the twigs are club-shaped. The verrucae are densely packed, younger forms arising between the larger and more mature, so that little or none of the actual coenenchyma is visible. They are about 1 mm. in diameter, 0.5 mm. in height, and dome-shaped. They are densely spiculose, the projecting spine of the characteristic *Echinomuricea* spicules standing almost vertically, and forming a palisade-like protection to the anthocodiae. The latter are small, white and completely retractile. In the coenenchyma, long, thick, spindle-shaped spicules occur, arranged longitudinally. The following are the chief types of spicules: (1) Long spindles with rugose warts, some of these even bearing short warty branches, bifurcate in some cases; (2) Short, thick spindles with rugose warts; (3) Spiny, conical needles, from the base of which arise from two to five warty branches; (4) Rough needles, giving origin to irregular, spiny, almost foliaceous expansions. The spicules are pale red in colour. The colour of the colony is almost brick-red, but the anthocodiae are white. This species belongs to the rough-neededled section.

GENUS ECHINOGOROGIA, K  lliker.

In "Icones Histologicae," p. 136, K  lliker thus defines this genus: "From *Muricea* I set apart a group previously partly *Muricea* partly *Eunicea*. They are *Primnoaceae* with a horny axis, small superficial spiny spicules of peculiar form, and with verrucae but little developed. The spicules of the surface are partly unilateral thorny spindles and unilateral thorny clubs, and in all species peculiar thorny plates ('Stachelplatten'), 0.28 to 0.63 mm. in length and 0.21 to 0.5 mm. in breadth, which probably represent triplet or quadruplet forms. The coenenchyma when thicker, shows still other forms, *e.g.*, warty spindles and double stars with transitions to double wheels. The poorly developed calyces show the same forms as the coenenchyma, and the polyps have simpler warty spindles in the usual order."

Wright and Studer ("Challenger' Report," vol. xxxi. p. 118) thus emend the original diagnosis: "All upright colonies, for the most part branched in one plane; branches either free or anastomosing into a network. Coenenchyma thick not transparent. Polyps small but slightly prominent, papilliform, usually in close spirals surrounding the stem. The operculum is for the most part feebly developed and is sunk within the margin of the polyp calyx over which it does not project; it is formed of two or three spicules at the base of the tentacles. The spicules of the coenenchyma and polyps are very numerous: unilateral

spiny spindles, one-sided spiny clubs, echinulate discs, warty spindles and double stars; also peculiarly formed 'Blattkeulen' whose dentate folia project beyond the cœnenchyma and give it a prickly appearance. In species with a well-developed cœnenchyma, where the polyps are somewhat apart from one another, the one-sided spiny spindles predominate, while in others with closely packed polyps the 'Blattkeulen' or spiny discs are present. The axis is always horny and frequently compressed."

Summary of Previously Described Species of Echinogorgia.

E. flabellum, Esper. Ridley, "Report on the Collections of H.M.S. 'Alert,'" p. 337.

The spicules of the general cortex are especially noteworthy:—

I. Fusiform, pointed at each end and generally curved, with scattered prominent, usually simple, tubercles often of large size, 0.21 to 0.42 mm. in length and 0.053 to 0.087 in breadth (including tubercles).

II. Larger fusiform with blunt ends, slightly curved, with blunt tubercles on one side and sharper on the other, 0.56 mm. \times 0.177 mm. to 0.25 mm.

III. Irregular tri- and sex-radiate with rough tubercles; maximum diameter 0.177 mm. to 0.25 mm., that of single arms, 0.035 mm. to 0.053 mm.

IV. A form of "Blattkeule" very varied in shape, 0.25 mm. to 0.35 mm. in length and breadth.

The spicules of the verrucæ are simple, fusiform and slightly tuberculate.

Note.—Ridley's specimens were more extended laterally than that figured by Esper. The mean diameter of the branches was .1 (?) to 1.5 mm., but one specimen from Port Curtis had a mean diameter of 2 mm. The fundamental colour is a light yellowish-brown. In some young specimens from the Straits of Malacca and Queensland anastomosis is wholly wanting.

Localities: Port Molle, Queensland, 12-20 fathoms; Port Curtis, Queensland, 5-11 fathoms.

Ridley is of opinion that *Echinogorgia* is allied to *Plexaura*.

E. pseudosassapo, Kolliker. (a) Kolliker, "Icon. Hist.," vol. i. p. 136; (b) Wright and Studer, "'Challenger' Report," vol. xxxi. p. 119. Plate XXIII. fig. 9; Plate XXV. fig. 5; (c) Thomson and Henderson, "Ceylon Pearl Oyster Reports".

(a) Kolliker's *E. pseudosassapo* was identified by him with Esper's *Gorgonia sasappo*, var. *reticulata*, the type specimen of which was re-investigated. Kolliker gave no additional description but figured two of the characteristic echinulate discs.

(b) Richly branched in one plane, anastomosing to form a loose network.

Branches in alternating series ; twigs have knob-like endings. The cœnenchyma is thick and rough. The polyps are in closely packed spirals ; they are small and wart-like with oval slit-like mouths ; the polyps are at most 1 mm. in diameter and 0·5 mm. in height. The spicules are (1) spiny discs of triangular shape armed with warts, 0·63 mm. \times 0·18 mm. ; (2) spiny discs, much-branched and usually trifoliate, 0·24 mm. \times 0·14 mm. ; 0·25 mm. \times 0·2 mm. ; 0·21 mm. \times 0·13 mm. ; (3) multi-radiate stellate forms from which a smooth pointed ray goes off ; (4) spindles frequently curved and unilaterally rayed, 0·16 mm. \times 0·05 mm. ; 0·25 mm. \times 0·07 mm.

The operculum is formed by short smooth spicules, two to three at the base of each tentacle. The spicules are of a dark red colour. The general colour of the colony is dark coral red. The axis is horny, flexible, elastic, brown ; the twigs are yellowish.

Locality : Torres Straits.

(c) A young specimen of a crimson-red colour. Diameter of branches, 2 to 3 mm. The surface of the cœnenchyma is very rough and there are practically no verrucæ ; the polyps are yellowish and the mouth is seen as a very precise oval aperture. The spicules are very variable :—

- (1) Fusiform, pointed at both ends with distant tubercles, 0·2 to 0·4 mm. long.
- (2) Larger fusiform with tubercles.
- (3) Large and variable “Blattkeulen” often roughly triangular, with a shaft often divided into tubercled branches and a foliar expansion with 2 to 5 teeth. Some measure 0·6 mm. in length.
- (4) Irregular stellate forms with transitions to irregular discs, 0·2 mm. \times 0·3 mm.
- (5) Tri- and hex-radiate forms with transitions to stellate type.

The spicules are not quite in agreement with the description and figures given by Wright and Studer, but the differences do not seem important.

Locality : Ceylon.

E. ramulosa, Gray = *Borella ramulosa*, Gray. Wright and Studer, “ ‘Challenger’ Report,” vol. xxxi. p. 120. Plate XXIII. fig. 8 ; Plate XXV. fig. 6.

This species differs in some interesting particulars from the typical species of the genus. The polyps are more prominent than in any other species and are well developed on one surface of the stem only. The one-sided spiny spindles and spiny discs are predominant and are arranged in the cœnenchyma in a pavement-like fashion. (This distinguishes it from *E. flabellum*.) It is richly branched in one plane and the branches and twigs are free. (Gray’s specimen had anastomosis.) The lateral branches terminate in slight thickenings. The stem and branches are flattened on two sides ; the cœnenchyma is

thick and rough. The polyps are prominent, blunt conical warts with a diameter of 1 to 1.5 mm.; the operculum is conical. The distribution of the verrucae is varied; they occur all over the twigs and finer branches, only on the short diameter of the flattened branches, and on one surface of the main axis. The spicules of the coenenchyma are mainly spindles but very irregular; those around the base of the polyps are arranged peripherally usually in two rows, and these are surmounted by groups of three spindles at the base of each tentacle. The "æolis-like" spindles are 0.6 mm. in length and the spiny discs are 0.3 mm. \times 0.2 mm. The axis is horny and fibrous varying in colour from black to light brown.

Locality : Philippine Islands ; 120 fathoms.

Echinogorgia modesta, Studer, "Challenger' Reports," vol. xxxii. p. 9. Plate IV. fig. 1 ; Plate V. fig. 8.

The coenenchyma is thick and rough ; the polyps are low and arranged in close spirals ; the calyces are about 0.8 mm. apart, and 0.8 mm. in diameter by 0.4 mm. in height ; they stand perpendicular to the coenenchyma and have a somewhat elongated oval outline with the long axis parallel to the length of the stem. The mouth is truncated and has eight lobes ; the oral region of the polyp is wholly retractile. The spicules on the surface of the coenenchyma are broad, warty and club-shaped, or thick, spindle-shaped bodies often almost flat ; those towards the apex are densely covered with rough warts granulated or branched ; they have the following measurements : 0.276 mm. \times 0.096 mm. ; 0.258 mm. \times 0.21 mm. ; 0.228 mm. \times 0.078 mm. ; 0.22 mm. \times 0.108 mm. ; 0.21 mm. \times 0.12 mm. In the deeper layers the spicules are more spindle-shaped and occasionally thicker at one end than the other ; they bear scattered warts which project straight outwards and are terminally expanded or branched :— 0.56 mm. \times 0.084 mm. ; 0.24 mm. \times 0.066 mm. ; 0.18 mm. \times 0.042 mm. Rod-like bodies with elongated unbranched warts are 0.8 mm. in length and 0.03 mm. in breadth. The colour is yellowish-white.

Locality : Bay of Kobé, Japan, 8-50 fathoms.

Note on the Distribution of the Various Species of Echinogorgia.

All the species of this genus so far as are known belong to the Indo-Pacific Ocean.

E. flabellum, Esper : Port Molle, Queensland, 12-20 fathoms ; Port Curtis, Queensland, 5-11 fathoms ; Andamans.

E. pseudosassapo, Köl liker : Torres Straits ; Ceylon Seas ; Andamans.

E. ramulosa, Gray : Philippine Islands ; Persian Gulf ; Andamans.

E. modesta, Studer : Bay of Kobé, Japan, 8-50 fathoms.

E. intermedia, Studer : N.W. Australia, Mermaid Straits, 50 fathoms ; Andamans ; Arakan Coast, 13 fathoms.

E. multispinosa, Thomson and Henderson : Ceylon ; Andamans ; Coromandel Coast, 14-15 fathoms.

E. macrospiculata, n. sp. : Andamans.

E. flexilis, n. sp. : Arakan Sea, 13 fathoms.

The following doubtful species are only imperfectly known : *E. sassapo*, Esper, Mauritius ; *E. furfuracea*, Esper ; *E. cerea*, Esper ; *E. cancellata*, Verrill, N.W. Australia ; *E. umbratica*, Esper, East Indies ; while *E. aurantiaca*, Milne Edwards, has been found off Callao.

Species of Echinogorgia in this Collection.

Echinogorgia flabellum, Esper.

Belonging to this species there is a large reticulate colony 18 cm. in height and 16 cm. in maximum breadth. The specimen is damaged at the base, the attachment being absent. There are three or four large branches which in all probability arose from a single base. The colony is expanded in one plane and anastomoses are fairly abundant. The main branches are sinuous and the secondaries arise in all directions, many running horizontally and fusing, others turning upwards and again branching. The general tendency is towards a sub-parallel arrangement.

The coenenchyma is thick and rough. It presents a glistening arenaceous surface due to the projecting folia of the spicules. The colour is almost coral-red.

The polyps are disposed over the whole surface and are densely crowded on the twigs. The verrucæ are about 1 mm. in height and 0.65 mm. in diameter at the base. In shape they resemble truncated cones, but the projecting spicules give them a very prickly appearance, and there is a distinct circlet of spines around the circular opening, which is directed slightly upward towards the stem. The anthocodixæ are completely retractile leaving a small circular opening. The tentacular operculum is feebly developed and consists of two spindles enclosing an angle, and one row at the base. The tentacles are white in colour.

The horny axis is usually flattened in the plane perpendicular to that of ramification but is cylindrical in the younger twigs. In the main branches, where the section is elliptical the lengths of the long and short axes are 2.25 mm. and 1 mm. respectively. The colour is black at the base but fades gradually to a pale yellow in the twigs.

The spicules are very heterogeneous in form but the following are the more prominent types with measurements in millimetres :—

(a) Small bent spindle-shaped spicules with a few warts, 0.15×0.025 ; 0.18×0.02 ; 0.18×0.035 .

(b) Short, thick, very rough spindles with long pointed projections, 0.3×0.08 .

(c) Three very divaricate rays with a foliaceous expansion divided into three to five smooth points not all in one plane, 0.225×0.18 ; 0.225×0.15 ; 0.18×0.15 .

(d) Irregular folia projecting from an irregularly expanded and branched base, 0.225×0.175 ; 0.2×0.125 .

(e) Clubs with the thickened end foliaceous and smooth, 0.22×0.12 ; 0.2×0.1 .

(f) Irregular forms almost scale-like, tri- to multi-radiate, edges very rough, 0.275×0.125 ; 0.22×0.125 ; 0.15×0.1 .

(g) Bent warty spindles with a somewhat ovoid foliaceous expansion arising from the middle of the convex side, 0.2×0.12 .

(h) Small stellate forms, 0.1×0.1 .

(i) Small crosses, 0.11×0.1 .

(j) Small double stars, 0.1×0.075 .

(k) Small irregular forms, 0.1×0.07 .

(l) Spicules like the side view of a butterfly at rest, 0.11×0.075 .

Locality: Andamans. Marine Survey.

A complete colony in the Wood-Mason Collection, has its basis of attachment on a piece of dead coral. It is 130 mm. in height and 105 mm. in breadth. The branching is in one plane and anastomosis is frequent. Some of the larger branches exhibit a distinct flattening in a plane perpendicular to the plane of ramification. The axis of the stem and main branches is almost black in colour, but this fades gradually to a transparent yellow in the finer twigs. The coenenchyma is somewhat thin and the polyps appear as small yellow domes with a black dot on the summit representing the anthocodiae. The spicules agree in detail with those of the specimen described above.

Echinogorgia pseudosassapo, K  lliker. Plate III. fig. 9.

Belonging to this species are several specimens, only one of which is complete. It is of a dark red colour while most of the others are light brown, one being much darker than the rest. The perfect specimen measures 10.5 cm. in height and 11.5 cm. in maximum breadth. From a spreading base, which extends over a stone to a distance of 3 mm. in diameter, the main stem arises and grows vertically upwards to the full height of the colony. It measures 3.5 mm. in diameter at the base, gradually diminishing to 2 mm. near the tip. The branching is irregular and in one plane. Most of the branches arise at about 45° , but

a few come off almost perpendicularly, soon diverging so as to extend almost parallel to the others. The smaller branches have a diameter of about 2.25 mm. and maintain this throughout almost their entire length. There are a few traces of anastomosis in this specimen but in some of the others it is absent. One feature worthy of notice in this specimen is the fact that there are numerous cirripede galls overgrown by cœnenchyma bearing polyps and also twigs. As many as seven arise from one gall, several of which bear smaller twigs. These intrusive growths naturally stand perpendicular to the plane of ramification.

A light brown specimen is not so robust and there is more anastomosing. The branching is mostly all on one side of the main stem. In another specimen some of the finer twigs which are club-shaped at the tips diverge considerably from the plane of ramification.

The cœnenchyma is thick and densely packed with warty and spiny spicules of great diversity in form, which give the colony a very rough appearance. Sometimes large spindles appear on the surface lying in any direction. Nearly all the spicules, however, are arranged perpendicularly to the stem.

The polyps are disposed irregularly over the whole cœnenchyma and appear as roughnesses to the naked eye. On the lighter specimens they are more conspicuous because the black anthocodæ stand out in contrast to the lighter cœnenchyma. When expanded the verrucæ appear cylindrical with eight projecting points, but when contracted they are wart-like and the points fit together so as to be hardly noticeable. They are very rugose in appearance owing to the projecting folia of the spicules. The anthocodæ are wholly retractile and the operculum is feebly developed. Its triangular lobes do not project beyond the verrucæ. They consist of about three spindle-shaped spicules, two forming the sides of a triangle and an almost horizontal curved spindle forming the base. Below this there are three or four rows forming a simple collaret.

The axis is horny and slightly opaque. In the red specimen the colour is brown and yellow, but in the brown specimens it is black.

The following are some of the types of spicules with measurements in millimetres :—

- (a) Large warty spindles, 0.7×0.3 ; 0.85×0.2 .
- (b) Smaller „ „ „ 0.3×0.05 ; 0.32×0.12 .
- (c) Three or four warty rays from which arises a foliaceous expansion, bi-, tri- or quadri-dentate, 0.4×0.25 ; 0.42×0.25 ; 0.375×0.225 ; 0.35×0.3 .
- (d) Irregularly branched plates, smooth or slightly warty, 0.25×0.2 ; 0.3×0.15 ; 0.3×0.2 .
- (e) Tri-radiate warty forms, rays tapering markedly, 0.7×0.4 ; 0.8×0.35 .
- (f) Spiny spindles of the anthocodæ, bent often almost in a semicircle, with most of the spines on the convex side, 0.3×0.02 ; 0.4×0.02 .

Locality : Andamans.

The Wood-Mason Collection contains several specimens which, though exhibiting great diversity in general appearance and robustness, must nevertheless be placed in this species. Their apparent diversity is due in part to more vigorous growth, in part to different degrees of retraction of the polyps.

(a) A robust but damaged portion of a colony, 185 mm. in height and 75 mm. in breadth without basal attachment. The axis at the lower extremity is 6 mm. in diameter, while in the twigs it is $1\frac{1}{2}$ -2 mm. The cœnenchyma is thick and the verrucæ are very prominent, so that in some of the twigs a maximum breadth (including the verrucæ) of 3·5-4 mm. is attained. The colour is dark brownish-red.

(b) A much-battered specimen 130 mm. in height with no basal attachment. The diameter of the stem is 5 mm. Most of the branches have been broken off, but in general appearance it resembles (a).

(c) A small portion, evidently terminal, of a large colony, 110 mm. in height and 35 mm. in breadth. The branching is not strictly confined to one plane. The polyps are not greatly retracted and resemble those of (a). The anthocodiæ appear yellowish. The colour is the same as in (a) and (b).

It is not improbable that the above three specimens are parts of what must have been one huge colony.

(d) A large flabellate colony, 115 mm. in height and 150 mm. in breadth, with its basis of attachment on a piece of coral. The branches vary little in diameter and anastomosis is frequent. The verrucæ are small and dome-like ; the anthocodiæ are very much retracted. This gives a very uniform appearance to the colony. An average diameter of a branch is $1\frac{1}{2}$ -2 mm., but the diameter of the main stem at the base is 3·5 mm. There is a hint of flattening in the branches in a plane perpendicular to the plane of ramification. The colour is dull red.

(e) A fragmentary portion of a medium-sized colony, 135 mm. in height and 95 mm. in breadth. The cœnenchyma is rubbed off in many places, and in several of these encrusting Polyzoa take its place. The branching is not confined to one plane. The verrucæ are small and dome-like ; they are more prickly than in the preceding four specimens. The colour is almost vermilion red.

Echinogorgia ramulosa, Gray. Plate VIII. fig. 3.

A large graceful colony, 16 cm. high and 19 cm. broad, of an almost black colour, represents this species. The main stem, which is 11 cm. long, arises from a spreading base 2·5 cm. in diameter. It is not complete but does not appear to have been much longer. The whole colony is branched in one plane. At a distance of 1·2 cm. from the base the first branch, which is 6 cm. long,

is given off. This bears secondaries, one of which measures 12 cm., and a tertiary 9 cm. in length. Other branches arise along the main stem, the longest of which is 13.5 cm. These long slender branches are very characteristic of the specimen. They give rise irregularly, however, to smaller branches which sometimes anastomose. These arise generally at right angles and continue in this direction for a short distance, eventually curving upwards and diverging outwards in a sinuous manner.

The lower part of the main stem is slightly damaged and is devoid of coenenchyma, but on the branches and twigs it is thick and roughly beset with foliaceous spicules.

The polyps are scattered irregularly over the stem and branches, but not very densely, being about 1 mm. apart. They are fairly prominent, cylindrical when open, conical when contracted. The anthocodæ are wholly retractile, with a feebly developed operculum. This consists of eight triangles made up of three spindles, two of which enclose an acute angle directed towards the distal end of the tentacles, the third forming an incomplete base. A simple collaret of three or four rows of curved spindles also occurs. Eight indistinct teeth can be discerned on the periphery of the expanded verrucæ.

The horny axis is of a black colour near the base, but fades to a pale yellow in the smaller twigs. For the first 2 cm. it is flattened in the plane of ramification, being elliptical in section, the two main axes measuring 0.45 cm. and 0.2 cm. respectively. Beyond this both on the main stem and on the branches the flattening takes place in the plane perpendicular to that of ramification.

The following are some of the types of spicules with measurements in millimetres :—

- (a) Large thick spindles, 0.6×0.2 ; 0.5×0.22 .
- (b) Three or four warty prominences from which a dentate foliaceous expansion arises, 0.32×0.2 ; 0.35×0.22 .
- (c) Irregularly branched discs, smooth or finely warty, 0.25×0.25 ; 0.3×0.25 .
- (d) Smaller warty spindles, 0.28×0.04 .
- (e) Club-like, very warty with slightly branched base, 0.3×0.1 ; 0.35×0.12 .
- (f) Spindles with folia on the convex side, 0.25×0.12 ; 0.2×0.1 .
- (g) Spindles of the anthocodæ : spiny, especially on convex side, 0.3×0.03 ; 0.28×0.03 ; 0.35×0.04 .

Locality : Persian Gulf, 48-49 fathoms.

Three colonies from the Andamans are also referable to this species. The following are their measurements in centimetres, length and breadth respectively : 150×90 , 100×50 and 90×80 . One is of a dark brown colour, while the others are much paler. The former shows slight anastomosis, but in the latter

this feature is very prominent. The details of branching, spiculation, etc., are essentially the same as in the more typical specimen. One colony is quite covered by a sponge-like growth.

Locality : Andamans.

Echinogorgia intermedia, Studer.

Plate IV. figs. 1 and 11 ; Plate VIII. fig 5.

Studer's description of this species is very short, but our specimens correspond with it closely.

Three small colonies of a dark red colour, the largest of which is 75 mm. in height and 50 mm. in maximum diameter. The branching is in one plane and anastomosis is not infrequent. The branches arise indefinitely and at varying angles.

The axis is horny, flexible and of a brownish-black colour. In the young twigs it is soft, collapsible and chambered.

The cœnenchyma is moderately thick and densely covered with small irregular spicules which interlock unequally and so give a spiny and glistening appearance to the surface. Irregularly scattered over this uniform layer and occurring at the base of the verrucæ are large scale-like spicules which give a characteristic appearance to the colony, but this feature is more prominent in some places than in others.

The polyps occur all round the circumference and seem to be in irregular spirals. The ends of the twigs are generally occupied by three divergent polyps between which there arises a small knob consisting of the end of the axis covered with cœnenchyma. The verrucæ are somewhat conical in shape, but some show a gentle curvature upwards and so appear dome-like, while others are constricted at the base. The spicules on the verrucæ have projecting points which diverge upwards and outwards and so present a spinose armature. The anthocodiæ are small and elongated. When partially withdrawn the tentacles are infolded and form a hemispherical knob. There is a distinct tentacular operculum consisting of a collaret of one to three (generally two) rows of curved spindles and eight points, each composed of two club-shaped spicules markedly bent near the base and touching on their convex sides. Occasionally in the small triangle thus formed there occurs a small spindle.

The spicules are almost crimson-red in colour and are very much branched and microtuberculate. The following are some of the more prominent types with measurements length and breadth in millimetres :—

(a) Massive scale-like forms covered with minute warts, 0.8×0.3 ; 0.5×0.25 ; 0.4×0.3 .

(b) Irregular discs with a varying number of projecting arms, 0.4×0.3 ; 0.3×0.2 ; 0.25×0.2 .

(c) Club-shaped forms with the expanded end very irregular and warty but the handle comparatively smooth, 0.5×0.3 ; 0.25×0.2 .

(d) Warty spindles curved and straight, 0.45×0.08 ; 0.4×0.07 ; 0.3×0.06 .

(e) Spiny spindles straight, curved, or "golf-club-shaped" from the anthocodæ, 0.4×0.04 ; 0.3×0.03 .

Localities: Andamans; Arakan Coast, 13 fathoms.

Previously recorded from Mermaid Straits, N.W. Australia, 50 fathoms.

Echinogorgia multispinosa, Thomson and Henderson.

Two colonies of a slightly orange colour, though differing considerably in general appearance from the type specimen, must be referred to this species.

The largest specimen, which is complete and bears a basal attachment, measures 15 cm. in height and 7 cm. in maximum breadth. It consists of a short main stem 3 cm. in length and 3 mm. in diameter from which two large branches are given off almost dichotomously. One of these has all the branches broken off, the other, which thus constitutes the colony, gives rise to secondary branches at very obtuse angles, in some cases perpendicularly. These again bear twigs in the same perpendicular manner. There is no hint of anastomosis in either specimen.

The second specimen is evidently part of an enormous colony. It measures 9.5 cm. in height by 5 cm. in breadth. It consists of part of a large stem of 5.5 mm. in diameter from which the main branch arises. This bears secondary branches and twigs in a manner similar to the first specimen. This colony is also interesting from the number of animals growing on it. The main stem is encircled by a great number of Zoantharian corals, but there also occur worm-tubes, barnacles, crinoids and several Polyzoa.

The polyps occur over the whole surface, being densely crowded on the smaller twigs. The verrucæ openings are protected by a projecting circlet of spicules within which a distinct eight-rayed operculum may be seen.

The cœenchyma is finely granular and almost transparent. The distinguishing feature of this species is the enormous variety of forms of spicules, the chief types being warty spindles, tuberculate or denticulate clubs, and irregular warty scales. In measurement these correspond exactly with the type specimen.

Previously recorded from Ceylon.

Localities: Andamans; Coromandel Coast, 14-15 fathoms. Marine Survey.

Echinogorgia macrospiculata, n. sp.

Plate V. fig. 7 ; Plate IV. fig. 8 ; Plate VIII. fig. 1.

A small orange coloured colony, at first very puzzling, must, we think, be referred to this genus. In external appearance it resembles an *Acis* very closely, but a microscopic examination of the spicules reveals its Echinogorgiid affinities.

It is 60 mm. in height and 60 mm. in maximum breadth. The branching is in one plane, but the branches arise quite irregularly and diverge upwards and downwards.

The axis is blackish, horny and comparatively soft and flexible.

The coenenchyma is thick, and when viewed with a lens appears glistening and seems to be covered with large fairly regular scales. There are two layers of spicules, those of the inner layer being very diverse in shape.

In one part a very peculiar feature is presented. Between the coenenchyma, which is supported by a film-like growth, and the axis there is a large cavity which extends for about 30 mm. along the main branch and so gives it a very dilated appearance. No trace of any animal could be found in the cavity, but it is not impossible that it formed the retreat of some small crustacean, as in *Solenocaulon*. But it may perhaps be a pathological condition.

Polyps occur all over the coenenchyma. The verrucæ are fairly prominent and dome-like, and are covered with the same type of scale as the coenenchyma. The anthocodiæ are extremely minute so that at first we were inclined to think that they had all been detached, but closer investigation revealed small globular bodies with infolded tentacles. The aboral surface of the tentacle showed a single minute spindle, or in some cases two spindles. No collaret was visible.

The spicules are of a pale orange colour. The following are the chief types with measurements length by breadth in millimetres:—

(a) Massive microtuberculate scales recalling those of *Acis*, 0.9×0.4 ; 0.8×0.3 ; 0.7×0.3 ; 0.6×0.3 .

(b) "Blattkeulen" with one end spindle-shaped and very warty, 0.45×0.375 ; 0.4×0.3 ; 0.35×0.3 ; 0.25×0.25 .

(c) Bi-palmate or almost stellate forms, 0.3×0.2 ; 0.275×0.2 .

(d) Warty club-shaped forms with very irregular ends, 0.4×0.3 ; 0.4×0.25 ; 0.4×0.2 .

(e) Irregular discs, 0.5×0.4 ; 0.4×0.3 ; 0.35×0.25 .

(f) Spindles, 0.3×0.05 ; 0.25×0.05 ; 0.15×0.025 .

This is a very characteristic form and is distinguished essentially by (1) the enormous massive warty scales, (2) the diminutive anthocodiæ which are out of all proportion to the verrucæ, and (3) the primitive pseudo-operculum.

Locality ; Andamans.

This new species is represented in the Wood-Mason Collection by a magnificent orange-coloured colony, 160 mm. in height and 60 mm. in breadth. The branching is not altogether in one plane, but there is a distinct approximation to it. The axis near the base is brownish-black in colour; in the twigs it is yellowish. The coenenchyma is thick, and consequently the branches vary little in diameter, the average being about 2 mm. The branching is sparse and the branches arise at various angles. The verrucæ are almost inconspicuous; the anthocodiæ are very minute and white in colour.

Echinogorgia flexilis, n. sp. Plate 1. fig. 4.

This species is represented by a fragment of a colony consisting of part of a branch devoid of coenenchyma, from the middle of which there arises almost perpendicularly a short rugose twig. The axis of the larger branch measures 3 cm. in length and 1.5 mm. in diameter, that of the smaller 5 cm. in length and only 0.5 mm. in diameter. With the coenenchyma the latter is 2 mm. thick.

The coenenchyma is moderately thin but is densely beset with foliaceous spicules standing perpendicularly, giving it a very rugose appearance. The general colour is a light orange brown.

The verrucæ are dome-like and very prominent. When expanded they are inclined slightly to the stem, but when retracted they stand perpendicularly. Their exterior is similar to that of the coenenchyma, the folia being arranged circumferentially. They are slightly flattened and measure 1.35 mm. in length, 1.25 mm. in breadth, and 1.2 mm. in height. They are disposed all round the coenenchyma, but for the most part in four rows, the base of one merging into the base of the next. The anthocodiæ are wholly retractile, but when expanded measure 1.5 mm. in length, the tentacles scarcely exceeding 0.5 mm. There is a very primitive operculum, consisting of eight points and a few horizontally disposed spindles forming a sort of collaret. Sometimes there is only one spicule in the point, at other times two enclose an acute angle directed towards the distal end of the tentacles, while in a few cases two bent spindles touch on their convex sides but with both ends diverging outwards.

The axis is very calcareous, cylindrical and of a brownish-black colour. The surface is marked by a few indistinct longitudinal striæ.

The spicules of the coenenchyma are practically all of one type, *viz.*, one, two, or more warty rays with a flat foliaceous expansion. The folia are somewhat semicircular and are generally smooth, but occasionally they bear a few warts or a radial ridge which disappears towards the circumference.

The following are some of the measurements in millimetres;—

0.4 × 0.3 folia 0.2 long.

0.35 × 0.35 „ 0.18 „

0.3 × 0.15 „ 0.2 „

0.35 × 0.3 „ 0.2 „

The spicules of the anthocodæ are spiny spindles and measure in millimetres, 0.3 × 0.04; 0.3 × 0.06; 0.2 × 0.03; 0.1 × 0.02.

Locality: Arakan Sea, 13 fathoms.

GENUS MENACELLA, Gray.

This genus was founded by Gray for *Gorgonia reticulum*, Pallas ("Ann. Mag. Nat. Hist.," Ser. 4, vol. v. p. 406), but Ridley ("Ann. Mag. Nat. Hist.," Ser. 5, vol. ix.) points out that Gray's species does not agree with that established by Pallas, so that it must be termed *Menacella reticularis*, Gray, nec *reticulum*, Pallas. Gray's diagnosis is as follows: "Coral very much branched, fan-shaped, irregularly reticulated; stem simple. Bark very thin formed of numerous very slender fusiform spicules in bundles placed in different directions. Polyp cells short, cylindrical, covered with spicules like the bark, with a smooth, convex eight-rayed lid, placed close together on the sides of the branchlets and more scattered and further apart on the sides of the branches." To this Ridley adds: "In its spiculation it differs very decidedly from the members of the genus *Villogorgia*, in having none but simple tuberculate fusiform spicules, with strongly micro-tuberculate or exfoliating tubercles; the spicules are black in colour with the exception of the tubercles which are colourless; the largest measure 0.5 × 0.101 mm."

In the present collection there is a colony which comes nearest to this genus but differs from it in certain particulars.

Menacella gracilis, n. sp.

Plate VIII. fig. 16; Plate VI. fig. 6.

A large colony 115 mm. in height and 80 mm. in maximum breadth, branched in one plane and of a creamy-white colour. The branches arise almost perpendicularly and diverge only slightly from their original direction. The main stem extends to the very top of the colony and tapers markedly from 2.25 mm. at the base to an almost thread-like fineness. There is no anastomosis. The axis is horny and soft, very flexible in its upper half. It is dark in colour in the older portions but gradually changes to pale yellow in the twigs.

The cœnenchyma is very thin and allows the dark axis to shine through in the lower parts. The spicules are arranged longitudinally and this disposition is continued up the sides of the verrucæ. Many cirripede galls occur and these

are overgrown by polyp-bearing cœnenchyma, as many as eight to ten polyps arising from one gall.

The polyps occur mainly on two sides of the stem and branches, but owing to a spiral twisting of the stem in some places this is not always obvious. The verrucæ are small and dome-like and are separated by intervals of from 1 to 2 mm. They are sub-alternate in position. The tips of the twigs are occupied by two almost opposite polyps. The anthocodiæ are completely retractile. There is a distinct tentacular operculum consisting of a collaret of two to three rows of curved spindles and eight points each composed of four to five spicules with no definite arrangement. This can be wholly withdrawn so that only the tips appear within the verrucæ. On the verrucæ the spicules are arranged longitudinally and in most cases a segregation into eight groups is discernible, presenting a slightly serrate margin around the aperture.

The spicules are essentially spindles and are colourless. The following are the more important types with measurements length by breadth in millimetres :—

- (a) Cœnenchyma: (1) Spindles covered with tuberculate warts, straight, curved or S-shaped, 1.2×0.15 ; 1×0.12 ; 0.9×0.1 ; 0.8×0.08 ; 0.6×0.05 .
- (2) Small warty cylinders some approaching a capstan-shape, 0.11×0.06 ; 0.1×0.04 .
- (3) Small crosses with a very distinct X-shaped marking, 0.15×0.1 ; 0.1×0.1 .

(b) Anthocodiæ: Warty spindles, 0.35×0.06 ; 0.3×0.05 ; 0.25×0.04 .

Locality: Andamans.

GENUS BEBRYCE, Philippi.

Philippi, "Archiv. f. Naturgesch.," Bd. i. p. 35, 1842.

Kölliker, "Icon. Hist.," pt. ii. p. 137, 1865.

G. von Koch, "Fauna und Flora d. Golfes von Neapel," xv. 1887, p. 54.

This genus was established by Philippi in 1842. Milne-Edwards did not accept it and noted the opinion of Valenciennes that the genus was founded on a gorgonid axis on which *Sympodium coralloides* was growing parasitically. Lacaze-Duthiers took the same view. According to Philippi *Bebryce* had a character which surprised Milne-Edwards, *viz.*, freely projecting non-retractile polyps hitherto known in no gorgonid. By this, however, he meant the verrucæ. In *Bebryce* the polyps are retractile just as usual.

The following may be regarded as the accepted generic diagnosis: The colony is branched, with a thin cœnenchyma and relatively high sub-cylindrical calyces which are alternately arranged on the axis. The spicules of

the coenenchyma form externally a layer of scales which exhibit more or less irregular or dentate margins, one or more, longer or shorter, warty processes being given off from each centre. Beneath this there is a layer of warty irregular spindles, including tri- or hex-radiate forms. Spicules of the same shapes are found in the polyp calyces.

Several species have from time to time been established so that the following are now recognised: *B. mollis*, Philippi; *B. studeri*, Whitelegge; *B. philippi*, Studer; *B. hicksoni*, Thomson and Henderson; *B. indica*, Thomson; and to these we add in this memoir, *B. tenuis*, n. sp.

There are also in this collection several colonies which we had great difficulty in relegating to any well-defined species but which seem to link together *B. mollis*, *B. studeri* and *B. philippi*. The following summaries of these three species will show what the alleged specific differences are.

B. mollis, Philippi.

The branching is irregular, the verrucæ are almost or quite as high as broad; the oral portion of the polyps bears spicules. The spicules of the coenenchyma are in two layers, as also in the verrucæ. The colour is brownish, the polyps are translucent white; the branches and twigs are almost uniform in thickness. Anastomosis is common. The axis is light brown, rather delicate and flexible. Spicules: The outer layer consists of closely packed, short, conical bodies with their main axis perpendicular to the surface; the broader end is usually turned outwards and bears long finger-shaped processes often united in little groups; the middle portion is smooth and conical; the inner end bears four to six strong processes which again bear small secondary warts often divided at the ends. These spicules often show a marked middle line along their main axis. The spicules of the inner layer are of very different forms, but are deducible from the preceding more or less irregular spindles. On the extended polyp the basal part is free from spicules, but around the bases of the tentacles there is a well-defined ring consisting of pointed spindles; nearer the mouth on the base of each tentacle there is a triangular arrangement of three to four larger needles with strong warts. Between the tentacles there is usually a flat single needle; on the aboral surface of the tentacles there is a double row of small spicules.

Localities: Naples, Messina, Syracuse, "Mare Scoticum" (see Carus, "Prod. Faunæ Medit.," p. 60).

B. philippi, Studer, "Challenger' Report," vol. xxxii. p. 10. Plate III. figs. 3a, 3b; Plate V. fig. 7.

"The spicules of the coenenchyma and of the calyces form as in *B. mollis* two layers; the upper of these shows the characteristic form described by Kölliker and figured by von Koch. I observed, as the essential form, more or

less club-shaped or truncated conical structures, the broader part of which is directed outwards and beset with numerous warty protuberances. From the base proceed five or six star-shaped, root-like processes bearing simple or branched prolongations. Their height compared with their maximum breadth is 0·067 mm. to 0·065 mm. or 0·06 mm. to 0·054 mm. Sometimes the horizontal prolongations are united into a plate or scale from which simple or branched processes proceed ; this secures a large flat expansion whilst the club itself is shortened and finally is reduced to several slight projections in the centre of the plate. A line of division separating these spicules into halves is clearly distinguishable. Such plates have a diameter of 0·096 mm. to 0·15 mm. In the deeper layers are elongated spicules which at times incline to the form of the spicules of the cortex. They are elongated, club-shaped bodies with jagged spines, or spindle-shaped, straight or curved with sharply pointed spines. Dimensions, 0·77 mm. \times 0·01 mm."

Locality : Arafura Sea, 49 fathoms.

B. studeri, Whitelegge, "Alcyonaria of Funafuti," Part 2 ; "Mem. Aus. Mus.," III., Part 5, 1897. Plate XVII. figs. 21-25.

"The coenenchyma of the stem and walls of the polyps is densely coated with an external layer of minute spicules which viewed as opaque objects under the microscope present an irregular lenticular appearance ; when seen by transmitted light they reveal a very narrow smooth central constriction, an upper round disc, minutely granulose and somewhat opaque, a lower irregular tuberculate disc, quite translucent and frequently larger than the upper. The granular discs of these modified double-clubs are directed outwards and form a fairly uniform crust over the whole colony. Situated beneath this external layer are numerous larger spicules having a broad multilobate disc and a very short central boss surmounted by two or more tubercles. These spicules exhibit a distinct central line of union and the boss-like end is directed outwards. The polyps are provided with a collar of curved spicules ; on the lower dorsal surface of each tentacle are three curved spicules, a short one placed transversely with the convex side directed towards the summit and two placed longitudinally with their convex sides turned inwards. Embedded in the apices of the tentacles are a few short curved spicules with strong dentate processes on the convex side.

"(1) The cortical spicules are rarely longer than broad, 0·035 mm \times 0·03 mm. ; 0·04 mm. \times 0·035 mm.

"(2) Deep-seated, broad, star-shaped, the rays and disc being studded with warty tubercles. Diameter of disc from 0·05 mm. to 0·2 mm., those measuring about 0·15 mm. being the most common. The height is from 0·03 mm. to 0·1 mm.

"(3) The collar spicules are curved, sharp or blunt, pointed spindles with a few distant spines, 0.3 mm. \times 0.02 mm. ; 0.35 mm. \times 0.03.

"(4) The tentacle spicules are slightly spinose mostly on the convex side and frequently dentate at the apex, 0.1 mm. \times 0.02 mm. ; 0.15 mm. \times 0.03 mm.

"This species differs from *B. philippi* in the smaller size of the polyps and from *B. mollis* in spicular characters" (Whitelegge).

Bebryce mollis, Philippi. Plate IX. figs. 14, 15.

= *B. studeri*, Whitelegge.

= *B. philippi*, Studer.

We refer to this species, as established by de Philippi in "Archiv. f. Naturgesch.," Bd. i. p. 35, 1842, several small colonies the largest of which are 70 mm., 65 mm. and 60 mm. in length, and 45 mm., 70 mm. and 50 mm. in breadth respectively.

The branching in all cases is confined to one plane, and the branches arise for the most part at right angles, but after a longer or shorter distance run sub-parallel to the main stem. This mode of branching is repeated in the secondaries. In all the specimens one of the lowest primary branches is quite as strong as the main stem and in one case exceeds it in length.

The axis is horny, fibrous and comparatively slender; it is dark brown in the older parts but becomes paler and more delicate in the branches, eventually attaining an almost thread-like fineness in the twigs.

The cœnenchyma is moderately thick and when viewed with a lens presents a characteristically glistening and arenaceous appearance. There seem to be two distinct layers of spicules.

The polyps are alternate or subopposite, but in some places are so disposed as to appear in irregular loose spirals around the stem and branches. The twigs terminate with two almost opposite polyps which are generally larger than the others. The verrucæ are sub-cylindrical and about 1 mm. in height and 1 mm. in diameter at the base. The anthocodiæ are completely retractile, and on contraction the verrucæ show all stages from a distinct eight-rayed figure to its complete absence. On the anthocodiæ there is a collaret of curved spicules and surmounting this are eight groups of two or three converging spindles enclosing an acute angle with a smaller spicule in the interspace. On the aboral surface of the tentacles the spicules are arranged "en chevron". The colour of all the specimens is creamy-white.

The classification of these specimens was a matter of considerable difficulty, but we have thought it advisable to refer them to *B. mollis* and suggest the abolition of *B. philippi*, Studer, and *B. studeri*, Whitelegge.

B. philippi differs from *B. mollis* only in details of spiculation. *B. studeri*

differs from *B. mollis* in spicular characters and from *B. philippi* in the smaller size of the polyps (Whitelegge). Thus the question of species resolves itself into a question of spicules. In our specimens we find all the types of spicules which go to characterise the three species under discussion. We would therefore adopt the oldest name and rank the present forms as intermediate or linking types.

A beautiful specimen of this species in the Wood-Mason Collection confirms our opinion that *Bebryce philippi* cannot rank as a species distinct from *Bebryce mollis*. The spicular characters are not so different as to justify such a demarcation, while externally little or no difference is found. The colony is complete, and is 95 mm. in height and 60 mm. in breadth. The branching is in one plane, and the branches arise mainly at right angles though they may afterwards diverge from this mode of growth; they are almost uniform in diameter. The cœnenchyma is thick and arenaceous. The verrucæ are not very prominent but give an undulating appearance to the surface of the cœnenchyma. In these and other respects this specimen agrees with those just described.

The intimate relationship of the three species and our specimens may best be summed up in the following comparative table:—

<i>B. mollis</i> , Philippi.	<i>B. philippi</i> , Studer.	<i>B. studeri</i> , Whitelegge.	"Investigator" specimens.
Branching irregular. Anastomosis common.	Branching first at right angles then more or less parallel to the stem.	Branching generally at right angles.	Branching first perpendicularly then subparallel to the stem.
Colour brownish. Polyps translucent white.	Colour light brown to white.	Colour is pale yellowish-white.	Colour creamy-white.
Cœnenchyma moderately thick.	Cœnenchyma moderately thick. Polyps in irregular loose spirals.	Cœnenchyma thin. Polyps alternate, rarely opposite or arranged in rather loose irregular spirals.	Cœnenchyma moderately thick. Polyps alternate or subopposite, sometimes in irregular spirals.
Verrucæ almost as high as broad.	Verrucæ 1.1-5 mm. in height.	Verrucæ 0.8-1 mm. in height.	Verrucæ 1 mm. in height.
On anthocodiæ—well-developed crown, also points consisting of three to four spindles with one between.	On anthocodiæ—crown and points, each point composed of three spicules.	Crown and points arrangement on the anthocodiæ; each point consists of three spicules.	Crown and points on anthocodiæ; points made up of three spicules.
On the aboral surface of the tentacles there is a double row of small spicules.	On the apices of the tentacles there are a few short curved spicules.	Spicules on aboral surface of tentacles arranged "en chevron".	On aboral surface of tentacles spicules arranged "en chevron".
Spicules: Outer layer: short conical bodies; the broader end bears finger-shaped processes often united in groups; middle portion smooth; inner end with four to six processes often warty.	Spicules: As in <i>B. mollis</i> . Also club-shaped or truncated conical structures, the broader part of which is directed outwards and beset with numerous warty protuberances.	Spicules: (1) Cortical spicules longer than broad, 0.04×0.035 . (2) Deep-seated spicules—broad star-shaped warty. Diameter, $0.05-0.2$; height, $0.03-0.1$.	Spicules: Irregular discs with central boss, 0.12×0.18 ; "Capstans," 0.07×0.07 ; "Stars," 0.05×0.05 .
Inner: very diverse, like outer layer, also more or less irregular spindles.	The height to maximum breadth is as 0.067 to 0.065 , and 0.06 to 0.054 .	(3) Collar spicules curved sharp or blunt spindles with few distant spines, 0.35×0.03 ; 0.3×0.02 .	Spindles, 0.17×0.034 , 0.25×0.025 .
Anthocodiæ: curved spindles and strong warty needles.		(4) Tentacle spicules slightly spinose frequently dentate at apex, 0.15×0.03 ; 0.1×0.02 .	
Tentacles: small spindles.			

Bebryce tenuis, n. sp. Plate VI. figs. 4 and 5.

This species is represented by a beautiful slender specimen, 15 cm. in length, which is probably but a fragment of the upper part of an elongated flexible colony. It has an almost uniform diameter of about 2 mm. except at the tips which are sub-claviform in shape. At 4 cm. from the broken end a branch 3 cm. in length, with the end detached, is given off at an angle of about 60°. The stem and branch are both twisted on their long axis.

The coenenchyma is thick and dense. It consists of an almost uniform outer layer of scales, underlying which are warty, irregular spindles and a few double-clubs with very prickly warts. The surface is marked by ridges and depressions in several places.

The arrangement of the polyps is by no means constant, in some places they are disposed in four rows with a hint of a spiral, in others four occur at the same level around the circumference, while a decussate arrangement is not infrequent. The verrucæ are compressed domes 2 mm. long, 1.5 mm. broad and 0.75 mm. in height. The distance between the top of one verruca and that of the next on that line is about 3.75 mm., so that a gently undulating contour results. The anthocodiæ are small and when expanded protrude very little. The tentacles, which bear no spicules, are infolded, the whole anthocodia being then introverted.

The axis is horny, very slender and flexible. It is composed of long irregular strands and is hollow in the centre. The colour passes from a golden-brown to pale yellow at the tips.

The spicules are scales, spindles and double-clubs, all bearing spiny warts with a smooth stalk. Many of the scales are indented on two sides and simulate double-clubs, but forms of the latter occur with only a median constriction, there being no well-defined bare shaft. The following are some of the measurements in millimetres :—

(a) Scales, 0.24×0.14 ; 0.16×0.1 ; 0.14×0.14 .

(b) Irregularly warted spindles, 0.18×0.09 ; 0.14×0.08 ; 0.14×0.06 ; 0.11×0.04 .

(c) Large double-clubs, 0.14×0.1 ; 0.13×0.09 .

This species approaches *B. hicksoni*, Thomson and Henderson, with which, however, we cannot identify it. (See "Ceylon Pearl Oyster Fisheries Report," Part III. Roy. Soc. 1905, Supplementary Report XX. p. 294. Plate III. fig. 1; Plate VI. fig. 9.)

Locality : Off Gopalpur, 11 fathoms.

GENUS ACAMPTOGORGIA, Wright and Studer.

Acamptogorgia bebrycoïdes, G. von Koch.

A large colony of a dull brown colour 120 mm. in height and 110 mm. in breadth. It is branched in one plane and attached to a piece of coral. There are also a few smaller fragments. The specimens are typical, being almost identical with those described and figured by G. von Koch and also with those which occur in the Deep-sea Collection (*vide* Report). The verrucæ occur mainly on three sides and are more crowded on the twigs than on the older portions. They are nearly cylindrical and the anthocodæ are almost completely retracted throughout the whole colony. The twigs terminate with two almost opposite polyps, between which there is a small conical projection.

Locality : Off Malabar Coast, 36 fathoms.

Previously recorded from the Mediterranean, G. von Koch ; Azores, Hirondelle ; Indian Ocean Station 246, 11° 14' 13" N. and 74° 57' 15" E., 68-148 fathoms ("Investigator").

Two small specimens in the Wood-Mason Collection are also typical of this species. The larger, which is of a brownish colour, is 110 mm. in height and 75 mm. in breadth, while the smaller is 100 mm. high and 55 mm. broad. The latter is almost white in colour.

Acamptogorgia rubra, Thomson.

A small young colony, 60 mm. in length and 55 mm. in maximum breadth, irregularly branched in one plane. The mode of branching is very indefinite, but there is a distinct tendency for the branches to arise almost perpendicularly. The main stem is very sinuous so that the whole colony is somewhat one-sided. The diameter of the main stem and branches is almost uniformly 1 mm. The coenenchyma is very rugose.

The polyps are mostly lateral in position, alternate or sub-opposite, but young forms occur among the more mature verrucæ. The tips of the branches and twigs are occupied by two diverging almost opposite polyps. The verrucæ are cylindrical and have the same texture as the coenenchyma ; they are about 1 to 1.25 mm. in height and 1 mm. in diameter. The anthocodæ are completely retractile, but when partially retracted present a conical tentacular operculum. This shows a crown of two to three rows of curved spindles and eight points, each composed of a pair of club-shaped spicules touching on their convex surfaces almost throughout their entire length.

The coenenchyma is moderately thick and has a very prickly surface, due to the projecting folia of the spicules.

The axis is brownish-yellow in colour, fading to a pale yellow in the twigs. It is soft and flexible.

The spicules are essentially the same as those of the type specimen, but the thin curved spindles of the crown and the "golf-club" forms of the points, which together form the tentacular operculum, are slightly larger. Among the irregular types it is noteworthy that the folia are more rugose and dentate, and only in a very few cases is there the same distinct thinning off towards the edges.

Locality : Andamans.

Previously recorded from the Ceylon Seas, Herdman's Collection (Thomson, 1905, p. 178).

Acamptogorgia ceylonensis, Thomson and Henderson.

= *Echinomuricea ceylonensis*, Thomson and Henderson.

There is, in the Wood-Mason Collection, a small, slightly damaged colony, 85 mm. in height and 95 mm. in breadth. The branching is in one plane, and the branches are given off at varying angles. The axis is thin and flexible. The cœnenchyma proper is almost white, but it is supported by large foliaceous spicules. The folia of these project considerably beyond the level of the soft cœnenchyma, and produce a very rugose appearance. Each spicule stands out distinctly from the others, and presents its characteristic shape. Some are elongated, some appear tri-radiate, while others are quadri-radiate or star-shaped. Each of these main types shows much variation in form. The verrucæ are large and cylindrical. They are almost 1 mm. in height, and about 0.75 mm. in diameter. They are arranged laterally, and are about 1-1.5 mm. distant on the same side. The characteristic appearance of the cœnenchyma is continued into the verrucæ, and the projecting points or folia form a protecting armature to the anthocodia. This general characteristic appearance can be seen even with the naked eye. The following are the chief types of spicules : (1) Simple, warty spindles ; (2) Warty spindles bearing short spinose processes ; (3) Curved and straight warty spindles with foliaceous projections on one side, sometimes confined to the median portion, at other times extending almost the entire length of the spindle ; (4) Irregular, root-like processes, from the union of which arise irregular folia. Most of the folia are smooth, but a few bear warts near the base. The colour of the spicules is light red. The colour of the specimen is dark red.

Previously recorded from Ceylon.

Acamptogorgia tenuis, n. sp.

Plate III. figs. 4 and 8 ; Plate VIII. fig. 7.

The collection includes a large number of delicate colonies, all about the same size, growing on rock, calcareous algæ, gasteropod shells, sponge or

other Aleyonaria (*Solenocaulon*). They are branched in one plane and anastomose freely to form a wide-meshed network. Typical colonies measure 100 mm. \times 100 mm., 120 mm. \times 110 mm., and 120 mm. \times 100 mm. The last mentioned may be taken as the type. From a spreading base the short main stem rises to a height of 27 mm., with a diameter at the base of 2.25 mm. Three large branches are given off on one side and one on the other, but two smaller ones have become detached. Three of these four constitute the main support of the colony and ascend almost to the very top. From them smaller branches arise, some running sub-parallel with the main branches, others running almost horizontally and fusing with their neighbours.

The coenenchyma is very thin so that the colour of the axis gives its colour to the colony. With a low power the coenenchyma presents a very prickly appearance due to the spiny nature of the spicules.

Polyps occur all over the surface of the coenenchyma. They are separated by distances of 1 mm. to 2 mm., but are closer on the smaller twigs. The verrucae are cylindrical in shape and measure 0.5 mm. in height and 0.5 mm. in diameter. They are white in colour and very spiny. The spicules are arranged in eight indefinite groups with eight projecting triangular-shaped teeth around the circular opening. The anthocodiae are almost completely retractile. The tentacular operculum is very feebly developed and is horizontally disposed. At the base of the "points" there is a hint of a circlet of curved spindles.

The axis is horny and cylindrical with a cavity in the centre. The colour varies from brownish-black near the base to pale yellow in the twigs.

A very remarkable feature about the colony is the tendency to growth in the axial portion. There are thin foliaceous expansions in several parts, especially in the angles at the origin of the branches. Over the whole colony there are very abundant small cirripede galls and worm-tubes, all enclosed within a membranous expansion of the axis and overgrown with coenenchyma.

The spicules present the following types, with measurements length by breadth in millimetres :—

(1) A short, smooth or slightly warty spine proceeding from a branched almost foliaceous base :—

0.425 \times 0.2, length of spine only 0.05			
0.35 \times 0.15,	"	"	0.05
0.31 \times 0.15,	"	"	0.03
0.3 \times 0.2,	"	"	0.025
0.3 \times 0.125,	"	"	0.025

(2) Bent spindles warted on both concave and convex sides at the middle of the bend, 0.2 \times 0.05; 0.22 \times 0.05.

(3) Scale-like with smooth surface and irregular edges, 0.35 \times 0.1; 0.32 \times 0.25; 0.3 \times 0.2; 0.25 \times 0.2.

(4) Irregular crosses, 0.1×0.075 ; 0.175×0.1 .

(5) Slightly spiny spindles of anthocodiae, 0.25×0.025 ; 0.22×0.02 .

The number of epizoid animals is remarkable; acorn shells are very abundant, barnacles, crinoids and worm-tubes are not infrequent, while here and there incrustations of Polyzoa are to be seen; one young pearl oyster is also attached.

Locality: Andamans.

GENUS ACIS, Duch. and Mich.

Acis ceylonensis, Thomson and Henderson.

In the collection there are a number of specimens which, though they show the most diverse modes of branching, must nevertheless be grouped together under this species. All are attached to small loose pebbles, except one which has its disc of attachment on a piece of coral. The following are short descriptions of a few types of colony: (1) Simple, 1.3 cm. long with a basal diameter of 1.25 mm. (2) Simple, 2.5 cm. long and 2.25 mm. in diameter at the base. (3) Complete branched colony, 9 cm. long and 2 cm. broad. The lower 4 cm. are bare, but beyond this branches are given off subalternately in one plane. These arise nearly at right angles, but bend upwards and continue sub-parallel to the main stem. (3a) Two other more delicate colonies have this type of branching, but in neither is there such a long space devoid of branches. They measure 5.5 cm. in height and 2.5 cm. in breadth, and 3.5 cm. high by 1.5 cm. broad. (4) Complete colony 3.5 cm. in height. The main stem is 1.1 cm. in length where it bifurcates, one of the arms again giving origin to a small twig in the same plane. (5) Several colonies branched in one plane somewhat like (4), but there are frequent bifurcations, the smaller twigs, however, coming off irregularly. (6) A number of the colonies are branched in all directions, the branches sinuous and crossing but not fusing. It is interesting to note that specimens (1), (2) and (3) arise together from a single spreading base.

In spite of this diversity in branching there is no difference in polyps, spiculation, etc. The diameter of the branches hardly varies throughout their entire length except that the tips are club-shaped.

The coenenchyma is thick and has a rough arenaceous appearance. It is composed of large thick warty spicules which overlap in all directions, the largest measuring about 0.6 mm. by 0.3 mm. In some places they form an almost uniform layer and present a tessellated structure.

The polyps occur over the whole surface of the stem and branches at intervals of about 2 mm. They measure 1 mm. in height and 1.3 mm. in diameter at the base. When expanded the verrucae are cylindrical, but when closed are dome-like. The spicules are arranged longitudinally and in some

project as a fringe of teeth around the circular verruca-opening, fitting closely together and so becoming inconspicuous when closed. The anthocodiae are completely retractile and are black in colour. The tentacular operculum is feebly developed, consisting of eight triangular lobes at the base of the tentacles, surmounting a collaret of three or four rows of curved spindles. Each of the triangular parts consists of four spindles, in pairs, enclosing acute angles pointing towards the distal end of the tentacle, on which small spicules are arranged transversely. The axis is cylindrical. It is solid and of a dark brown colour at the base, but hollow and pale yellow in the younger parts.

The spicules present the following types, with measurements length by breadth in millimetres :—

(a) Coenenchyma : (1) Scales, 0.6×0.3 ; 0.6×0.25 ; 0.5×0.22 ; 0.5×0.2 ; 0.3×0.3 .

(2) Scale-like forms with x-shaped marking in the middle, 0.22×0.1 ; 0.2×0.08 .

(3) Thick warty spindles, 0.4×0.15 ; 0.4×0.1 ; 0.22×0.08 ; 0.22×0.06 .

(b) Anthocodiae : Spiny spindles, 0.22×0.02 ; 0.2×0.02 .

(c) Tentacles : Small scales and irregular crosses with x-shaped marking, 0.1×0.075 .

Several other specimens taken in the Andaman Sea, 53 fathoms, agree in every way with the above species except in the spicules which are smaller, more circular and more regularly disposed, forming a granular uniform layer.

Four beautiful colonies in the Wood-Mason Collection agree in detail with the above species. The largest and most complete is 180 mm. in height and 90 mm. in maximum breadth. It is almost pure white in colour and presents a beautiful tessellated structure. The verrucae stand out from the coenenchyma as small domes. The coenenchyma is thick, especially in the smaller branches ; consequently there is little variation in the diameter of the main branches and twigs. Most of the secondary branches arise perpendicularly but soon diverge to a direction almost parallel to the main branches which are very much elongated.

Localities : Andaman Sea, 53 fathoms ; off Puri, Rocky Bank, 10 fathoms ; off Ganjam Coast, 10 fathoms. Previously recorded from Trincomalee, Ceylon ; deep water off Galle, Ceylon.

***Acis indica*, Thomson and Henderson.**

To this species we refer a much damaged specimen 60 mm. in height and 60 mm. in maximum breadth. The main stem is broken near the base. The branching is very sinuous, some of the branches being almost S-shaped. They

arise mostly at right angles, but after a more or less sinuous course run sub-parallel to the main stem. The specimen is paler in colour than the type and the spicules are almost visible to the naked eye. In other respects the colony agrees with the description given in the "Ceylon Pearl Oyster Fisheries Report".

Locality : Andamans.

***Acis pustulata*, Wright and Studer.**

Plate I. figs. 6 and 7; Plate IX. figs. 5a, 5b.

There is in the collection a magnificent, upright, robust colony 22 cm. high and 25 cm. in maximum breadth. It is densely branched in one plane forming an almost felt-like fan-shaped mass. It has been attached to a rock by a claviform base 1.8 cm. in diameter and 1.5 cm. in height. The main stem measures 6 mm. in diameter near the base, it ascends to the top of the colony where it diminishes to 1 mm., equal in thickness to the smaller twigs.

It is very sinuous, diverging at a distinct angle at the origin of all the larger branches, and this is also a characteristic of the branches themselves. It gives off three large branches, the first at 2.5 cm., the second at 3.8 cm., and the third at 5 cm. from the base. The average diameter of these branches is 4 mm. Two ascend to the top of the colony but the third is broken. They also give off large sinuous branches, which, however, are few in number, and have an average diameter of 3 mm. Innumerable small twig-bearing branches arise from the main stem and larger branches and diverge in all directions, forming an intricate maze. These vary in thickness from 1.5 mm. to 1 mm. and seldom overlap.

The two sides of the colony are quite distinct in appearance, the dorsal being almost white, the ventral, polyp-bearing surface presenting a dotted structure due to the brown polyps which stand out in relief from the otherwise monotonous background.

The coenenchyma is thin on the main stem and is composed of a single layer of scale-like plates very irregular in outline. They conform in shape to the adjacent spicules but do not fit closely, so that each individual spicule can be distinctly seen with the naked eye although much more minute than on the younger portions. The general appearance is that of an irregularly tessellated pavement with somewhat circular tiles. In the upper part of the colony larger and more rectangular plates appear sparsely scattered over this fundamental layer. On the smaller branches, quadrangular and elongated diamond-shaped forms predominate, but there is also an inner layer of small rough spindles. The circular forms again appear in greater abundance on the twigs where the coenenchyma is much thicker and the scales more irregular. On the verrucae two types of arrangement seem equally frequent. In the first type there is the same tessellated structure as in the coenenchyma, but in the second

rectangular forms appear to be set on edge so that the rough side is projecting, thus presenting a more rugose appearance. When the verrucae are slightly expanded a row of spicules is seen projecting around the opening, but when contracted these fit closely together and become hardly recognisable from one another. A very characteristic feature about the coenenchyma is its deciduous nature, the spicules coming off in coherent plates.

The polyps occur over three sides of the stem and branches, leaving one side of the colony entirely free. They are separated by distances of about 1.5 mm. on the larger branches, but on the twigs the bases merge into one another. They are slightly cylindrical when open, but dome-like when closed, and measure about 1 mm. in height and the same in diameter. The brown coenenchyma appears between the loosely set spicules and makes them very conspicuous. In a very few of the twigs polyps occur on the dorsal or otherwise bare surface, but when this is the case few or none appear on the reverse side. The anthocodiae are completely retractile. There is a distinct sub-conical operculum formed of eight pairs of longitudinally arranged spindles which extend to the base of the tentacles, and a collaret composed of one or two rows of transversely disposed curved spicules. The spindles of the "points" are sub-parallel but diverge slightly towards the collaret.

The axis is horny and composed of longitudinal strands. It is very thick at the base, measuring 5.5 mm. in diameter. It tapers to an almost hair-like fineness in the twigs. It is very hard in the older parts, but soft and flexible in the younger branches. The interior contains a soft, white, pulpy core.

The spicules show great diversity in shape so that only a few of the most characteristic types can be noted. In general they may be termed scales or plates. They are very rough and very irregular in outline. The colour is an opaque white due probably to their extraordinary solidity and thickness. The following are some of the types, with measurements in millimetres:—

- (a) Irregular elongated plates, 2.2×0.5 ; 1.5×0.5 .
- (b) Somewhat circular plates with rugged edges, 0.25×0.2 ; 0.35×0.32 .
- (c) Irregular scales, 0.5×0.25 ; 0.9×0.4 .
- (d) Plates like "side view of a caterpillar," some with a projecting spine at the upper edge of one end, 0.9×0.25 ; 0.6×0.2 .
- (e) Numerous small rough spindles, from 0.35×0.05 and 0.3×0.03 to 0.12×0.015 .

On the branches they are of the same types:—

- (a) 0.9×0.3 up to 3×0.6 .
- (b) 0.4×0.3 ; 0.3×0.2 ; 0.5×0.2 .
- (c) 0.6×0.5 ; 0.8×0.4 ; 0.5×0.12 ; 0.4×0.22 .
- (d) 1.2×0.6 .
- (e) 0.3×0.05 ; 0.2×0.01 .

The spindles of the anthocodiae are smooth and bent with a few warts on a small part of the convex side ; 0.35×0.025 ; 0.3×0.02 .

Locality: Andamans. Marine Survey. Previously recorded from *Hyalonema*-ground, Japan.

***Acis ulex*, n. sp.**

Plate I. figs. 2 and 5 ; Plate IX. figs. 6a, 6b, 6c.

Representing this species there is in the collection a beautiful dendriform colony of a greyish colour, 8 cm. in height, 6 cm. and 5 cm. along the two diameters. The main stem arises from a very much expanded base and attains a height of 3.5 cm. where it measures 3.5 mm. in diameter, the basal measurement being 6 mm. From this stem several small branches are given off mostly at right angles, curving slightly upwards and giving origin to branchlets which diverge in all directions. At the end of the main stem five branches arise all about one level. These curve outwards and then inwards forming elongated arcs bounding a somewhat ovoidal central space. Branches arise on these and all are directed outwards. The smaller twigs diverge in all directions so that the whole colony reminds one forcibly of a well-developed "gooseberry-bush".

The coenenchyma is thin and is composed of a single layer of opaque, white, warty spindles or scales forming a sort of tessellated pavement-like structure, each spicule being visible to the naked eye. They do not fit closely together so that the dark axis shows up in the "chinks" in contrast to the white spicules. On the twigs the same types of spicules occur, but here they bear long spines which present a very prickly surface.

The polyps are distributed all over the surface of the coenenchyma. They are almost absent on the main stem, few in number on the larger branches, abundant on the twigs. They are small and wart-like but have a rugose appearance, due to the projecting spines of perpendicularly arranged spicules. The anthocodiae are not fully retractile. There is a well-developed tentacular operculum based by a collaret of six or seven rows of curved warty spindles. The arrangement of the spicules in the "points" of the operculum is very indefinite, varying to a certain extent with the number which may be anything between three and seven. Common types are (1) two enclosing an acute angle with one at the base ; (2) two diverging at both ends but touching at the middle, with one at the base ; (3) four arranged "en chevron," with two at the base.

The axis is horny and cylindrical in form. It is very thick at the base where it is black in colour. It tapers to a hair-like fineness at the tips of the twigs where the colour is yellow.

The spicules of the coenenchyma present the following types, with measurements in millimetres :—

(a) Spindles thickly beset with prickly warts, 1.1×0.15 ; 0.9×0.275 ; 0.8×0.25 ; 0.4×0.1 . A few of these bear a smooth spine.

(b) Prickly scale-like forms, 0.6×0.25 ; 0.3×0.15 .

(c) Tri- or tetra-radiate forms with foliaceous expansion much indented:—

0.45×0.35 ; foliaceous part 0.15 .

0.4×0.3 ; „ „ 0.2 .

(d) Very irregularly branched scales with a few smooth spines, 0.55×0.35 ; 0.45×0.45 ; 0.45×0.35 .

On the twigs the main types are:—

(a) Spindles with three or four spines sometimes bifurcated:—

1.1×0.2 ; spines 0.1 long.

0.9×0.18 ; „ 0.13 „

0.7×0.15 ; „ 0.12 „

(b) Scale-like forms with smooth spines on one side, warty spines on the other:—

1×0.5 ; spines 0.1 long.

1.1×0.6 ; „ 0.12 „

The spicules of the anthocodiae are warty and spiny spindles, 0.28×0.03 ; 0.25×0.2 .

Locality: Andaman Sea, 79 fathoms. Marine Survey.

***Acis rigida*, n. sp. Plate IV. figs. 4 and 9.**

A small complete colony growing on a detached piece of rock covered with Polyzoa; it is 55 mm. in height and 40 mm. in maximum breadth. The branching is in one plane and quite irregular; the younger branches and twigs are very slender compared with the older portions. The branches arise at varying angles and are markedly sinuous. The colour of the specimen is crimson-red.

The axis is horny; it is thick and hard in the older parts but soft and collapsible in the twigs. The colour varies from yellow to almost white.

The coenenchyma is packed with large scale-like irregularly disposed spicules in the main stem and larger branches, but in the twigs they approximate more nearly to spindle forms and are longitudinally arranged. They are so interlocked as to leave the surface comparatively level and pavement-like.

The polyps occur for the most part on three surfaces, leaving one aspect of the colony free, but occasionally an intruding polyp breaks the symmetry. In one or two places the polyps are crowded on this surface, but when this is the case the reverse aspect is quite bare. The verrucæ are small and wart-like and are supported by spindle-shaped spicules disposed longitudinally and projecting around the margin. They are about 0.75 mm. in height and the same in

diameter. The anthocodiae are almost completely retractile and bear an operculum consisting of eight groups of two to three spicules with no definite arrangement. The polyps are white in colour.

The spicules of the coenenchyma are crimson in colour and are densely covered with spinose warts; those of the anthocodiae are colourless and spiny. The following are the chief types, with measurements length by breadth in millimetres:—

(a) Coenenchyma: Large scales, 2×0.8 ; 1.2×0.6 .

Small irregular discs, 0.3×0.15 .

Forms approaching spindles, 1.8×0.3 ; 1.5×0.4 .

Spindles, 2×0.25 ; 1×0.2 ; 0.8×0.15 ; 0.6×0.1 .

Smaller spiny spindles, 0.3×0.1 ; 0.2×0.075 .

(b) Anthocodiae: Spiny or slightly warty spindles, straight or "golf-club" shaped, 0.3×0.075 ; 0.25×0.06 .

Locality: Andamans.

Another colony 150 mm. in length and 60 mm. in breadth is also branched in one plane. The branching is very irregular and the sinuous character of the branches is a marked feature. The axis of the main stem is brown and hard, and has a diameter of about 3 mm.; it diminishes to an almost thread-like fineness in the twigs where it is pale yellow and very soft and compressible. The polyps are disposed more laterally than in the other specimen, but in many cases they occur on three surfaces, leaving sometimes one surface, sometimes the other, free, but never both. Cirripede galls occur on the branches and are overgrown by polyp-bearing coenenchyma.

Locality: Andamans.

GENUS ELASMOGORGIA, Wright and Studer.

Elasmogorgia filiformis, Wright and Studer.

To this species must be referred five long thread-like specimens. Unfortunately only one can be regarded as complete, the remainder being broken at one or other of the ends.

The perfect specimen is 270 mm. in length and 1 mm. in diameter, and is attached to a shell. It bears a short branch, 28 mm. long, at a distance of 40 mm. from the base. The others are all simple and have a length of 260, 240, 160 and 100 mm. respectively.

The diameter scarcely varies in any of them except near the growing point of the colony where it is slightly club-shaped.

The coenenchyma is thin and is built up of long, slender, slightly warty spindles arranged longitudinally. On the greater part of the surface it is level,

but in several places—in one fragment especially—the spicules are grouped so as to form ridges and furrows, the axis being visible in the depressions.

The axis is horny and is composed of strands which give it an interrupted sheen when viewed with reflected light. It is very soft and collapses when sharply bent across, owing to the presence of a white, soft, pulpy core. It is black at the base, passing through a golden brown to a horny yellow at the tip.

The verrucæ are disposed in a sinuous row on one side but sometimes diverge so as to appear as if originating on two aspects. They stand perpendicularly and form slightly flattened cones. The largest are 1.5 mm. in breadth and 1 mm. in height. The distance between the verrucæ is by no means constant. The average is about 2 mm., but in some places they are 5 mm. apart, while in others their bases almost merge.

On the majority, the spicules are arranged pointing to the oral region, but by transitional stages they come to surround the verrucæ circumferentially. In some cases they are arranged in eight groups forming eight projections over the retracted polyps.

The anthocodiæ are wholly retractile, and when the tentacles are infolded there appears a quasi-operculum formed of eight irregular triangles of spindles. These extend to the bases of the tentacles on which the spicules are arranged transversely.

The spicules of the cœnenchyma and verrucæ are slightly warty spindles which taper in a marked degree. Those of the operculum are beset with simple spines. In length they have a fairly large compass. The following are some of the measurements in millimetres: 0.85×0.09 ; 0.6×0.06 ; 0.4×0.03 . The spicules on the tentacles measure 0.1×0.02 . The following points of difference from the type specimen may be noted:—

(a) In the “Challenger”-form the spicules are shorter and have much blunter ends, being also thicker in comparison to the length, *e.g.*, $0.62 \text{ mm.} \times 0.13 \text{ mm.}$, as compared with $0.85 \text{ mm.} \times 0.09 \text{ mm.}$ They also bear more numerous warts.

(b) The disposition of the verrucæ in two rows is not so marked in our specimens.

(c) Wright and Studer describe the position of the spicules on the verrucæ as circumferential while their figure depicts them as longitudinal. Both arrangements are to be seen on one colony.

Locality: Ganjam Coast, 28-30 fathoms.

Previously recorded from Arafura Sea, south of Papua, 28 fathoms.

Another specimen from the Arakan Coast, 13 fathoms, is 150 mm. in length and bears a long slender branch. The polyps, though predominantly on two surfaces, nevertheless show a marked tendency to a unilateral orientation.

The architecture of the verrucæ and polyps and the nature of the spiculation agree closely with the preceding example.

Elasmogorgia flexilis, Hickson.

Belonging to this species there is a slender slightly branched colony 330 mm. long from which three branches arise in an alternate manner. Two of these again bear a secondary branch. The longest of the main branches measures 190 mm. All are elongated, filiform and very flexible. The general colour of the colony is a creamy-white.

The coenenchyma is thin, and is composed of slightly ovoid spicules arranged irregularly. In the verrucæ the spicules are more slender and disposed longitudinally.

The polyps are scattered over the whole surface on the lower portion, but near the ends of the branches they occur in a single row on each side, separated by two bare spaces where the black axis appears through the coenenchyma. The verrucæ are small and compressed, slightly cylindrical when expanded, wart-like when closed. Their bases merge into one another and give an undulating appearance. They are 1.75 mm. long, 1.25 mm. broad and 1 mm. in height. The anthocodæ are completely retractile; there is a definite operculum formed by long warty spindles which extend to the base of the tentacles forming eight triangular points. The disposition of the spicules in the points is not always the same. Sometimes they are arranged "en chevron" but more often irregularly; several short bent spicules always form the base and so constitute an indefinite collaret.

The axis is black in colour with a brownish tint. It is composed of longitudinal horny strands and is very thin and flexible.

The spicules have the following measurements in millimetres:—

(a) Warty ovoid forms, 0.21×0.175 ; 0.175×0.125 . These gradually merge into—

(b) Types tapering to one end, 0.3×0.125 ; 0.3×0.15 ; eventually appearing

(c) Club-like, 0.225×0.1 ; 0.15×0.075 .

(d) There are also warty spindles, 0.22×0.05 ; 0.2×0.1 ; 0.2×0.05 .

(e) Quadri-radiates with x-shaped marking, 0.12×0.06 ; 0.1×0.09 .

(f) Spiny spindles of anthocodæ, 0.3×0.04 ; 0.21×0.03 ; 0.2×0.03 ; 0.18×0.02 .

The largest spicules in the type specimen rarely exceeded 0.2 mm., but 0.3 mm. is by no means an uncommon measurement in our specimen, otherwise it agrees in detail with Hickson's description.

Locality: Andamans.

Previously recorded from Suvadiva, 20 fathoms, also 37 fathoms.

GENUS MURICELLA, Verrill.

This genus was established by Verrill ("Trans. Connect. Acad.," vol. i. 1869, p. 450) for the following species of *Muricea*: *M. flexuosa*, Kölliker; *M. nitida*, Kölliker; *M. humosa*, Kölliker, and *M. tuberculata*, Kölliker. To this list must also be added *M. umbraticoides*, Studer, although this form shows affinities to *Acis*. Since that time the following species have been added: *M. tenera*, Ridley; *M. perramosa*, Ridley; *M. purpurea*, Whitelegge; *M. crassa*, Wright and Studer; *M. complanata*, Wright and Studer; *M. gracilis*, Wright and Studer; *M. flexilis*, Hiles; *M. ramosa*, Thomson and Henderson (= *M. ceylonensis*, Thomson and Henderson); *M. bengalensis*, Thomson and Henderson; *M. rubra*, Thomson; *M. rubra*, Thomson, var. *robusta* nov. We must now add two more—*M. arborea*, n. sp., and *M. robusta*, n. sp.

The following is an emended diagnosis of the genus: Colony branched mainly in one plane with or without anastomosis; cœnenchyma generally thin, usually with an inner layer of small and an outer discontinuous layer of larger spicules; the verrucæ are short, subconical or wart-like and usually arise at right angles from their bases; the axis is horny and sometimes chambered, it may be thin and slender or hard and almost inflexible; the spicules of the cœnenchyma are long warty spindles, shorter forms occur in the verrucæ where they are generally arranged longitudinally in eight bundles with eight projecting teeth, but sometimes transversely, obliquely or "en chevron"; the anthocodiæ are completely retractile; the tentacular operculum is usually fairly well developed, consisting of a "crown and points".

For a classification of the species we find no character or characters so absolutely constant as to afford a basis on which groups might be formed, but it may be useful to discuss, in a general way, the chief points of generic importance.

(a) *Branching*.—In this connection it is noteworthy that all the species with one exception, viz., *M. arborea*, n. sp., are branched in one plane; in the latter the twigs arise in four directions, i.e., in two planes at right angles to one another; in some species, however, e.g., *M. complanata*, Wright and Studer, small twigs arise from the plane of ramification on one surface, a fact which might probably be explained by a study of habitat. The angle of origin of the branches though not absolutely definite is yet fairly important; it seems almost constant in certain species, e.g., the angle is (1) acute in *M. nitida*, Verrill; (2) about 45° in *M. complanata*, Wright and Studer; (3) approximately a right angle in *M. umbraticoides*, Studer; *M. gracilis*, Wright and Studer; *M. ramosa*, Thomson and Henderson, and *M. arborea*, n. sp. In *M. rubra*, Thomson, the angle of origin varies from 30° to 90° and cannot be relied upon.

Anastomosis has been recorded for *M. umbraticoides*, Studer, and *M. ramosa*, Thomson and Henderson, but is not constant even in one species.

(b) *Axis*.—The axis is horny and in most cases slender and flexible, *e.g.*, *M. gracilis*, Wright and Studer; *M. crassa*, Wright and Studer, and *M. flexilis*, Hiles; but in *M. ramosa*, Thomson and Henderson, especially in the older parts, it is very hard and rigid. It is sometimes chambered in the younger portions and is faintly striated in *M. bengalensis*, Thomson and Henderson. Typically it is cylindrical, but in the older parts of *M. rubra*, Thomson, *M. complanata*, Wright and Studer, and *M. flexilis*, Hiles, it is flattened in the plane of branching, while in *M. ramosa*, Thomson and Henderson, the flattening takes place in the plane perpendicular to that of ramification.

(c) *Cœnenchyma*.—In most cases the cœnenchyma is thin and transparent; it contains a single layer of spicules, or an inner continuous layer of small spicules and an outer discontinuous layer of larger spicules arranged longitudinally. In *M. crassa*, Wright and Studer, it is thick and dense and contains several layers of spicules, being in some places twice as thick as the axis. In *M. umbraticoides*, Studer, it is thin; in *M. tenera*, Ridley, thin and paper-like; in *M. rubra*, Thomson, it is thin and almost smooth. In *M. gracilis*, Wright and Studer, it is comparatively thick but fairly even, while in *M. bengalensis*, Thomson and Henderson, it is thick and rough. In *M. ramosa*, Thomson and Henderson, it is thin, almost transparent and very rugose, while in *M. arborea*, n. sp., it is thick and very irregular in contour. The nature of the surface is often characteristic, as may be seen by contrasting that in *M. rubra*, Thomson, and *M. purpurea*, Whitelegge, with that in *M. ramosa*, Thomson and Henderson, and *M. arborea*, n. sp. Another noteworthy feature is that while the spicules in the younger branches and twigs are often very large and longitudinally arranged, those in the main stem and larger branches are much smaller and show no definite arrangement. This is most noticeable in *M. ramosa*, Thomson and Henderson, *M. rubra*, Thomson, and *M. arborea*, n. sp. The fact must be borne in mind in identifying a species from a fragmentary portion of a colony.

(d) *Polyps*.—The disposition of the polyps shows considerable diversity. In the majority of the species, especially on the twigs, they are arranged on the lateral surfaces, but in *M. complanata*, Wright and Studer, they occur on three surfaces. In *M. ramosa*, Thomson and Henderson, they arise on the surface of the main stem and larger branches in some specimens, while in others this surface is quite bare; on the twigs they are lateral and sub-alternate. In *M. nitida*, Verrill, they occur mainly on one surface, while in *M. tenera*, Ridley, and *M. perramosa*, Wright and Studer, they are lateral and alternate. In *M. gracilis*, Wright and Studer, and *M. crassa*, Wright and Studer, they are disposed spirally on the thickened ends of the branches. The ends of the twigs are generally occupied by *two* almost opposite polyps with between them a small projection consisting of the tip of the axis covered by cœnenchyma, *e.g.*, *M. tenera*, Ridley, *M. flexilis*, Hiles, *M. purpurea*, Whitelegge, and *M. arborea*,

n. sp., but in *M. crassa*, Wright and Studer, the end is occupied by *three* polyps—the terminal expression of a spiral arrangement.

(e) *Verrucae*.—The verrucae are mostly sub-conical, but in *M. perramosa*, Wright and Studer, they are hemispherical, and in *M. arborea*, n. sp., they are cylindrical with a terminal dome; and while those of the twigs of *M. ramosa*, Thomson and Henderson, are typical, those of the main stem and branches are small and wart-like. They generally stand at right angles to the axis and are sometimes flattened in the plane of ramification, e.g., *M. rubra*, Thomson, and also markedly elongated in the direction of the axis, e.g., *M. purpurea*, Whitelegge, and *M. rubra*, Thomson, var. *robusta*. The armature consists of spicules similar to those of the coenenchyma, but smaller and arranged for the most part longitudinally. In *M. nitida*, Verrill, they are upright or oblique; in *M. tenera*, Ridley, they are upright or transverse; in *M. purpurea*, Whitelegge, they are in eight indistinct bundles, while in *M. crassa*, Wright and Studer, they are in eight bands of two rows. In the majority, however, they are disposed in eight groups with eight projecting teeth, e.g., *M. perramosa*, Wright and Studer, *M. complanata*, Wright and Studer, *M. ramosa*, Thomson and Henderson, etc., while in *M. arborea*, n. sp., near the base they are transverse but higher up in eight bands of pairs “en chevron,” the angle gradually diminishing until generally a single pair projects from each band at the margin.

(f) *Anthocodiae*.—The anthocodiae are completely retractile and there is generally a fairly definite tentacular operculum which, however, is hidden when the verrucae are closed. The operculum consists of a “crown” and “points” but the number and arrangement of the spicules varies in the different species. In *M. perramosa*, Wright and Studer, and *M. crassa*, Wright and Studer, it is very poorly developed, in the latter consisting of a single pair on each tentacle; in *M. complanata*, Wright and Studer, the “crown” or collaret is very indefinite; in *M. gracilis*, Wright and Studer, it is almost horizontal and consists of two or three spicules on the tentacles; in *M. bengalensis*, Thomson and Henderson, the collaret consists of one or two rows with a pair on each tentacle; it is fairly definite in *M. tenera*, Ridley, and well developed in *M. nitida*, Verrill; in *M. rubra*, Thomson, the collaret consists of two or three rows with four pairs “en chevron” at the base of each tentacle, and in *M. ramosa*, Thomson and Henderson, it is high and dome-like with five rows in the collaret and eight pairs “en chevron” on the tentacles; in *M. arborea*, n. sp., there is no definite “crown and points,” but there are abundant spicules on the aboral surface of the tentacles. In addition to an operculum, spicules arranged longitudinally occur on the aboral surface of the tentacles in many species.

(g) *Spicules*.—These are typically warty spindles, straight, curved or S-shaped. In some, e.g., *M. tenera*, Ridley, they are densely covered with papillose warts, but in *M. flexilis*, Hiles, the warts are few and more or less rounded.

The maximum length varies greatly in the different species, *e.g.*, in *M. gracilis*, Wright and Studer, 0·46 mm., in *M. umbraticoides*, Studer, 0·6 mm., in *M. flexilis*, Hiles, 1·105 mm., in *M. complanata*, Wright and Studer, 1·25 mm., in *M. nitida*, Verrill, 2 mm., in *M. arborea*, n. sp., 3·5 mm., in *M. ramosa*, Thomson and Henderson, 4·5 mm., and in *M. purpurea*, Whitelegge, 5·5 mm. Smaller forms occur in the verrucæ, the inner layer of the coenenchyma, and in the tentacular operculum. In addition to these spindles tri- and quadri-radiate forms occur in *M. crassa*, Wright and Studer, and club-shaped types in the verrucæ of *M. gracilis*, Wright and Studer. In *M. umbraticoides*, Studer, the outer spicules are very broad and have the warts developed mainly on one side and are somewhat scale-like, while in *M. arborea*, n. sp., many of the spindles have a median constriction and a slight swelling on either side of this.

Geographical distribution.—All the species hitherto described are Indo-Pacific, thus :—

North Pacific Ocean : (a) off Japan : *M. nitida*, *M. complanata*, *M. perramosa*.

South Pacific Ocean : (a) off Queensland : *M. tenera*.

(b) Funafuti : *M. purpurea*, *M. flexilis*.

(c) Arafura Sea : *M. umbraticoides*, *M. crassa*, *M. tenera*.

Indian Ocean : (a) Mauritius : *M. perramosa*.

(b) Bay of Bengal : *M. complanata*, *M. ramosa*, *M. rubra*, *M. bengalensis*.

(c) Ceylon Seas : *M. nitida*, *M. complanata*, *M. ramosa*, *M. rubra*, *M. arborea*.

(d) Persian Gulf : *M. ramosa*.

Bathymetrical distribution.—All are found in comparatively shallow water except *M. nitida* and *M. perramosa* which were dredged from a depth of 345 fathoms. Other depths : *M. umbraticoides*, 49 fathoms ; *M. tenera*, 14-20 fathoms ; *M. perramosa*, 90 fathoms ; *M. gracilis*, 16-20 fathoms ; *M. ramosa*, 48-49 fathoms ; *M. rubra*, 18 fathoms ; *M. bengalensis*, 88 fathoms ; and *M. arborea*, 13 fathoms.

The following abbreviated descriptions recapitulate the characters essential for the identification of species.

Muricella umbraticoides, Studer.

Muricea umbraticoides, Studer. "Uebersicht der Anthozoa Alcyonaria der Gazelle," "Monatsber. Akad. Wiss. Berlin," Taf. III. fig. 16 a, b, 1878, p. 650.

Muricella umbraticoides, Wright and Studer. "'Challenger' Report," vol. xxxi. p. 124.

Colony branched in one plane ; branches arise at almost right angles and

rarely anastomose ; terminal branches short and often club-shaped at the end. Coenenchyma thin, with *small* warty spindles *with warts larger on one side than on the other*. In the superficial layer they lie apposed in pavement-like fashion, and among them are smaller warty spindles : these also cover the verrucæ. Verrucæ short, arising at right angles to the stem, with circular apertures with eight lobes. The dimensions of the spindles, length and breadth in millimetres, are :—

(a) Large, 0.6×0.3 ; 0.5×0.3 ; 0.3×0.1 .

(b) Small, 0.25×0.07 ; 0.23×0.07 ; 0.2×0.04 .

The axis is horny and blackish-brown in colour. The colour of the cortex is greyish-white.

Localities : Arafura Sea, South of Papua, 49 fathoms, Wright and Studer.

Muricella nitida, Verrill.

M. nitida, Verrill. "Amer. Journ. Sci. Arts," xlv. (1868), p. 412.

M. nitida, Wright and Studer. "'Challenger' Report," vol. xxxi. p. 129.

M. nitida, Thomson and Henderson. "Ceylon Pearl Oyster Fisheries," Aleyonaria—Report XX. Roy. Soc., p. 302, 1905.

Branched closely and flattened in one plane ; *branches occur up to the fifth order at acute angles* ; all the branches and twigs remain of nearly the same diameter throughout. On the stem and branches the *polyps occur mainly on one surface of the colony*, but more abundantly towards the margin ; *on terminal twigs laterally about 2 mm. apart*. Verrucæ truncated cones, diameter at base and height about 1 mm. ; usually at right angles, but near the apex obliquely towards the stem. Tentacular operculum a bright yellow low cone within the verruca, consisting of eight triangular groups of three spicules and a well-developed collaret. Spicules of verrucæ upright or oblique. Spicules (1) coenenchyma—spindles curved or S-shaped, covered with spinose warts, 2 mm. \times 0.13 mm. to 1 mm. \times 0.125 mm. ; (2) verrucæ—spindles, 0.8 mm. \times 0.125 mm., 1 mm. \times 0.125 mm. ; (3) tentacular operculum—spiny spindles, 0.36 mm. \times 0.05 mm. ; (4) collaret—curved spiny spindles, 0.75 mm. \times 0.075 mm. Axis horny, flexible, brown to yellowish. Colour—shining coral-red with tentacular operculum yellow.

Localities : *Hyalonema*-ground, off Japan, 345 fathoms ; Ceylon Seas.

Muricella tenera, Ridley.

M. tenera, Ridley. "Zool. Coll. of the 'Alert,'" p. 335. Plate XXXVI. 4 figs.

M. tenera, Wright and Studer. "'Challenger' Report," vol. xxxi. p. 124.

M. tenera, Hiles. "Gorgonacean Corals from Funafuti," P.Z.S., p. 50, 1899.

Branching erect, approximately in one plane ; branches pinnate, sub-alternate ; main stem and larger branches flattened in the plane of ramification.

Cœnenchyma thin and paper-like, level but slightly rough, semi-transparent. Verrucæ in two lateral series, alternate, and alternately directed to front and back. Twigs terminate in two opposite polyps. Verrucæ, *large upright truncated cones 1 mm. in height* with eight triangular teeth. In Ridley's specimen the spicules were arranged perpendicularly, but in the "Challenger" form they were disposed in horizontal rows. Oral region protected by a covering formed by the spicules on the basal portions of the tentacles. Spicules—spindles straight or curved, *densely covered with closely-set rough warts* :—

(a) *Cœnenchyma*, 1 mm. \times 0.178 mm.

(b) Verrucæ, 1.5 mm. \times 0.28 mm. ; 0.9 mm. \times 0.14 mm.

(c) Polyps, 0.35 mm. \times 0.07 mm.

Locality : Port Molle, Queensland, 14-20 fathoms ; off the Ki Islands, south of Papua, 140 fathoms.

Muricella perramosa, Ridley.

M. perramosa, Ridley. "Ann. Mag. Nat. Hist." Ser. 5, vol. x. p. 128, 1882.

M. perramosa, Wright and Studer. "'Challenger' Report," vol. xxxi. p. 126.

Branched in one plane, *very slender*. *Cœnenchyma thin*. Verrucæ *hemispherical*, sometimes elongated in the direction of the long axis of the branch ; *on all parts of the stem and branches ; on two sides on the twigs ; height and basal diameter, 0.5 mm. ; 1 mm. apart*. Spicules on the verrucæ arranged in eight groups prolonged into eight teeth. Tentacular operculum often sunk into the mouth of the calyx. Spicules :—

(a) *Cœnenchyma* : (1) Spindles densely covered with prominent tubercles terminally swollen and roughened, 1.7 mm. \times 0.145 mm. ; 1 mm. \times 0.18 mm. ; 0.42 mm. \times 0.053 mm.

(2) Irregular linear, 0.12 mm. to 0.14 mm. \times 0.07 mm.

(b) Verrucæ—sub-fusiform with small warts, 0.28 mm. \times 0.038 mm.

(c) Tentacular operculum—spindles, 0.265 mm. \times 0.025 mm. ; 0.2 mm. \times 0.05 mm.

Colour (1) carmine-red with white tentacular operculum ; (2) brick-red with yellowish tentacular operculum.

Localities : *Hyalonema*-ground, off Japan, 345 fathoms ; Mauritius, 90 fathoms.

Muricella purpurea, Whitelegge.

M. purpurea, Whitelegge. "Alcyonaria of Funafuti," "Mem. Aus. Mus.," p. 315, 1897. Plate XVII. figs. 26-29.

Colony erect, branched in one plane. Branches *arise perpendicularly*, then bend upwards. *Cœnenchyma thin* on stem and branches, thicker on twigs. *Spicules curved and twisted embracing the stem* ; the general arrangement is

longitudinal, but interlacing occurs. Polyps confined to one surface; they are alternate or opposite, and arise at right angles from the front and sides of the stem and branches, but occasional polyps on the older parts interrupt the otherwise continuous bare space. They are *conical and arise between large spicules*; height, 0·8 mm.; diameter at base, 0·8 to 1 mm.; diameter at tip, 0·4 to 0·7 mm. Two polyps occur on opposite sides of the tips of the twigs. The spicules on the verrucæ are in indistinct bundles. There is an operculum consisting of eight triangular points surmounting a definite collaret. The spicules are mostly warty spindles; they are light to dark red, and have the following measurements in millimetres :—

(a) Cœnenchyma, $5\cdot5 \times 0\cdot3$ to $1 \times \cdot15$.

(b) Verrucæ, $0\cdot6 \times 0\cdot15$ to $0\cdot3 \times 0\cdot05$.

(c) Collaret, $0\cdot3 \times 0\cdot03$.

(d) Points, club-shaped and spiny, $0\cdot15 \times 0\cdot02$.

(e) Tentacles, slightly curved with few spines, $0\cdot1 \times 0\cdot01$.

Axis horny, brownish-yellow at base. Colour of colony in spirit—dark purplish-red.

Locality : Funafuti.

Muricella crassa, Wright and Studer.

M. crassa, Wright and Studer. “ ‘Challenger’ Report,” vol. xxxi. p. 131.

Colony branched in one plane; branches and twigs thickened at apex with three polyps pointing in three directions. Cœnenchyma thick, containing several layers of spicules. Polyps bluntly conical, arranged in irregular spirals, and standing vertically at intervals of 1 to 1·5 mm. Calyces with a single layer of spicules disposed in eight bands of two rows and terminating in eight teeth. Operculum consists of a single converging pair at the base of each tentacle; small spicules also lie on the distal portion of the tentacles. Spicules :—

(a) Outer layer : warty spindles usually curved, $1\cdot2$ mm. \times $0\cdot1$ mm. ; $0\cdot9$ mm. \times $0\cdot125$ mm.

(b) Inner layers : Spindles, also *tri-* and *quadri-radiate* forms.

(c) Calyx : spindles, $0\cdot9$ mm. \times $0\cdot1$ mm.

(d) Operculum : spindles, $0\cdot43$ mm. \times $0\cdot04$ mm.

(e) Tentacles : spindles, $0\cdot2 \times 0\cdot05$ and less.

Axis horny, flexible, brown, relatively thin and weak, being 1 mm. thick in twigs of 5 mm. diameter. Colour—greyish-white.

Locality : “Challenger” Station 190; Arafura Sea, 49 fathoms.

Muricella complanata, Wright and Studer.

M. complanata, Wright and Studer. “ ‘Challenger’ Report,” vol. xxxi. p. 125.

M. complanata, Thomson and Henderson. "Ceylon Pearl Oyster Fisheries," Alcyonaria—Report XX. Roy. Soc., p. 303, 1905.

Branched in one plane; branches arise at 45° , secondaries come off straight; stem and branches flattened in plane of ramification. Coenenchyma relatively thick, not transparent, consisting of one layer or at most two layers. Verrucæ, truncated cones standing at right angles; they alternate on the sides of the stem and branches and are somewhat narrowed in the plane of branching. The spicules are arranged in eight groups and form eight teeth around the oral opening. The tentacular operculum shows an "en chevron" arrangement; collaret feebly developed. Axis thin, horny, flexible, black to yellowish. The spicules are densely covered with prickly warts. In the centre the warts are at right angles, but towards the ends they are directed to the apex.

(a) Coenenchyma, 1.25 mm. \times 0.25 mm. to 0.94 mm. \times 0.12 mm.

(b) Calyx, 0.63 mm. \times 0.1 mm. to 0.43 mm. \times 0.12 mm.

(c) Operculum, 0.41 mm. \times 0.05 mm. to 0.28 mm. \times 0.09.

The colour scheme is very varied (see description).

Localities: *Hyalonema*-ground, off Japan, 345 fathoms; west of Periya Paar; Gulf of Manaar, West Coast of Ceylon; Andamans.

Muricella flexilis, Hiles.

M. flexilis, Hiles. "Gorgonacean Corals from Funafuti," "Proc. Zool. Soc.," p. 49, 1899. Plate III. figs. 1 and 2.

Very slender; branched in one plane; branches slightly flattened in the plane of ramification. Twigs terminate in a small flat expansion consisting of two lateral polyps close to the apex.

Coenenchyma very thin, the brown axis appearing through it.

Verrucæ lateral, 0.9 mm. in height and 0.8 mm. in basal diameter.

Polyps only partially retracted.

Spicules *small*, spindle-shaped, *with warts not thickly placed*; 1.105 mm. \times 0.09 mm.; 0.83 mm. \times 0.073 mm.; 0.18 mm. \times 0.027 mm.

Colour—dirty white.

Locality: Funafuti, 40-71 fathoms.

Muricella gracilis, Wright and Studer.

M. gracilis, Wright and Studer. "'Challenger' Report," vol. xxxi. p. 129.

Delicate thin stem from which branches arise at moderate intervals *at right angles*; stem and branches slightly thickened at apex; coenenchyma thick. Verrucæ on stem and branches on two sides *in alternate rows*; on the thickened ends of the branches *spirally around the whole periphery*. Verrucæ *low*, scarcely projecting above the coenenchyma; basal diameter, 0.5 mm.; eight teeth project

around the oral cavity. Tentacular operculum *almost horizontal*, consisting of *only 2 or 3 spicules on the tentacles*; does not fill the mouth of the verruca. Spicules :—

(a) Cœnenchyma—small spindles, curved, rarely straight, frequently club-shaped, covered with warts which are sometimes branched, 0·46 mm. \times 0·05 mm., 0·3 mm. \times 0·012 mm.

(b) Verrucæ—club-shaped, spinose, arranged longitudinally, 0·3 mm. \times 0·033 mm., 0·2 mm. \times 0·03 mm.

Axis thin, horny, flexible, brown.

Colour—cœnenchyma and verrucæ, coral red; tentacular operculum, whitish.

Locality : Admiralty Islands, 16-20 fathoms.

Muricella ramosa, Thomson and Henderson.

M. ramosa, Thomson and Henderson. "Ceylon Pearl Oyster Fisheries," Alcyonaria—Report XX. Roy. Soc., p. 301, 1905.

= *M. ceylonensis*, Thomson and Henderson, *op. cit.*, p. 302.

Colony branched in one plane, with or without anastomosis; branches and twigs opposite or alternate, arising almost at right angles. Cœnenchyma thin and composed of warty spindles, straight, curved, or S-shaped, which often stretch between two polyps. Verrucæ *small*, standing perpendicularly, and disposed in short spirals or more often laterally; the base is surrounded by a number of horizontally disposed spindles, but the verruca proper is formed of longitudinally arranged spindles of the same type as in the cœnenchyma. The tentacular operculum is well developed and dome-like; it consists of a collar of about *five* transverse rows and eight points, each point consisting of about *eight* spindles arranged "en chevron". The axis is black in colour in the older parts, but in the twigs it assumes a pale yellow tint; it is *flattened markedly in the plane perpendicular to that of ramification*, but in some places the flattening is *in the plane of ramification*. The spicules are spindles, straight, curved, or S-shaped, covered with numerous rough warts.

The following are measurements length by breadth in millimetres : 3·5 \times 0·3; 2·1 \times 0·26; 1·6 \times 0·2; 1·3 \times 0·2; 0·9 \times 0·16; 0·25 \times 0·06; 0·1 \times 0·02. The large spicules on some colonies may attain a length of 4·5 mm.

It seems to us that *M. ceylonensis* must be merged in *M. ramosa*.

Localities : Gulf of Manaar, off Galle and onwards up West Coast of Ceylon.

Muricella bengalensis, Thomson and Henderson.

M. bengalensis, Thomson and Henderson. "Alcyonaria of Indian Ocean," Part I. (1906), p. 78, Plate I. fig. 8, and VIII. fig. 2.

Branched in one plane; branches almost regularly alternate. Cœnenchyma

thick and rough; it contains *large, rather broad* irregular spindles, 2·8 mm. \times 0·3 mm., 2 mm. \times 0·4 mm. and 0·36 mm. \times 0·07. The verrucæ are steep truncate cones with projecting points around the apex; the spicules are arranged longitudinally. The polyps arise in a *steep spiral or are irregularly alternate* on the lateral surfaces of the twigs. The collaret consists of *one or two* rows, and standing upon this are the eight points each containing *two* spindles forming a triangle with the collaret; on the aboral surface of the tentacles there is a *band of longitudinally arranged colourless spicules*, 0·1 to 0·15 mm. in length and 0·02 mm. in breadth; in some this definite arrangement is not so visible. The axis is horny with a *faintly striated* surface. The colour is rose-red.

Localities: Andamans; Bay of Bengal, 88 fathoms.

Muricella rubra, Thomson.

M. rubra, Thomson. "Ceylon Pearl Oyster Fisheries." Supplementary Re-
T XXVIII., Aleyonaria—Appendix, Roy. Soc., 1905, p. 179.

Branching irregular in one plane; branches arise at varying angles and *bend in all directions*. There is a *very marked flattening* of the stem and larger branches in the plane of ramification. The cœnenchyma is fairly thin and *even*; in the younger portions the spicules are larger and arranged more longitudinally than in the main stem and larger branches. The axis is horny and slightly flexible, brown at the base fading to yellow in the twigs. The verrucæ are small truncated cones *embedded in* the cœnenchyma. In some specimens the main stem and large branches are devoid of polyps, in others they are irregularly covered with them; on the secondary branches they occur all round, while in the twigs they are sub-alternate on the lateral surfaces. Tentacular operculum feeble; *collaret of two or three rows*, points of about *four* spicules "en chevron". The spicules of the verrucæ are smaller than those of the cœnenchyma. In some they are disposed in eight groups, in others this is not so marked.

Locality: Ceylon Seas, Andamans, off Ganjam Coast, 18 fathoms.

Species of Muricella in this Collection.

Muricella complanata, Wright and Studer.

Plate V. figs. 10a and 10b.

Belonging to this species there are two complete colonies each with a basal disc of attachment. The larger specimen is 80 mm. in height and 100 mm. in maximum breadth; the general colour is rose-pink, but the verrucæ and polyps are pale yellow; the smaller is 70 mm. in height and 95 mm. in breadth; it is purplish-red with yellow polyps. In both cases the spicules are darker in colour towards the base. The branching is predominantly in one plane, but an

occasional twig directed towards a third aspect breaks the distinctly bilateral symmetry. The main stem and branches are cylindrical but the twigs are slightly flattened in the plane of ramification. The cœnenchyma is moderately thick and almost level; in some places it consists of a single layer of spicules, but in others there is an inner layer of small and an outer of larger spindles. The verrucæ are distinct, having a basal diameter and height of about 1 mm.; they are sub-conical and elongated in the direction of the axis. The spicules are arranged longitudinally and are smaller than in the cœnenchyma. There is a hint of an arrangement in eight groups with eight projecting points. The tentacular operculum is distinctly developed; at the base there is a marked "en chevron" arrangement, but this is not so noticeable further up, so that when much contracted it presents the appearance of a sheaf of spicules irregularly disposed; the collaret consists of two or three rows of slightly interlocking, transversely arranged, curved spindles.

The polyps occur in the older parts on three surfaces, but in the younger twigs an alternate arrangement seems to predominate; in the pink specimen they sometimes arise on the fourth surface. They stand almost at right angles, but seem to be directed alternately towards the flattened aspects of the colony. The ends of the twigs are occupied by two almost opposite polyps.

As in other species of *Muricella*, e.g. *M. ramosa*, there is a great difference in the size of the spicules on the main stem and on the younger branches. The longitudinal arrangement also, so definite in the twigs, is often lost sight of in the older parts.

In both specimens cirripede galls occur, overgrown by polyp-bearing cœnenchyma.

The measurements of the spicules are almost the same as those given by Wright and Studer for the "Challenger" specimen.

The great variety of colour occurring in this species is very marked. The "Challenger" type specimens were *pale rose with yellowish calyces*; one from Ceylon had a *violet tint with yellow polyps and verrucæ*, while another *violet* specimen had *rose-red spicules on the tentacles*; of the "Investigator" forms one is *rose-pink with yellow polyps*, the other is *purple-red with yellow polyps*.

Locality: Andamans.

Several other small colonies and fragments occur from the Andamans, Laccadives, 30-50 fathoms, and Arakan Coast, 13 fathoms. The following colour schemes occur: (1) *White*. (2) *Pink with pale yellow polyps*. (3) *Red with pale yellow polyps*. (4) *Violet with white polyps*. (5) *Purplish with yellow to white polyps*.

The Wood-Mason Collection contains two beautiful small specimens, one *purplish-red*, the other *creamy-white*, which we have no hesitation in referring to this species. The former is 95 mm. high and 45 mm. broad, while the latter

is 135 mm. in height and 65 mm. in breadth. The smaller colony bears numerous cirripede galls; these are completely overgrown by the coenenchyma, and from the overgrowth numerous polyps arise. *The anthocodiae are white.*

In the larger colony the spicules are not so regular as in the smaller as to size, arrangement or distribution; they stand out markedly from the coenenchyma.

Muricella ramosa, Thomson and Henderson.
= *M. ceylonensis*, Thomson and Henderson (1905).

In the collection there are a great number of colonies which undoubtedly belong to this species. Many of the characters are so variable that by means of a comparative study we have been enabled to find transitions which taken together connect this species with *M. ceylonensis* so that we cannot regard the latter as a valid species.

The branching as in most other species of this genus is in one plane; the branches arise generally at about right angles and seldom deviate from their original direction. In the majority of the specimens anastomosis is very abundant, in others it is scarce, while in several it is entirely absent, so that we cannot regard this as a character of specific moment, in fact we find that it depends largely on the closeness of the branching and no doubt also on the habitat. The axis is black and very hard in the older parts, yellow and more slender in the twigs, but on the whole the colony is very rigid. In the main stem and larger branches the axis is very much flattened in a plane perpendicular to that of ramification, but in the younger twigs it is almost cylindrical. The coenenchyma is very thin and uneven and allows the dark axis to appear through; it is composed of two layers, an outer discontinuous, consisting of large warty spindles disposed for the most part longitudinally, and an inner continuous layer of much smaller spicules arranged irregularly. As in *M. rubra* we find great disparity in the size of the spicules according to the position in the colony. In the younger twigs the spindles of the outer layer are more numerous, larger, and more definitely arranged. The verrucæ are more ragged than in many of the other species and the structure is by no means compact; they arise *between* the large spicules of the outer layer but in no regular manner. Sometimes they are encircled by a group of large spindles, at other times they arise close to the interlocking ends of the spicules. The disposition of the verrucæ is also a feature of great variability; in some places there is a distinct hint of a spiral arrangement, but in others they occur alternate, sub-opposite or irregular but markedly bilateral. The anthocodiae are not completely retractile. There is a distinct dome-like operculum consisting of eight triangular groups, each composed of about eight spindles arranged "en chevron," at the base of which there is a collar of about five transverse rows.

From a colony 160 mm. in height and 190 mm. in breadth the following measurements of spicules length by breadth in millimetres were taken :—

- (a) Twig, 2.5×0.35 ; 1.9×0.3 .
- (b) Older branch, 1.5×0.2 ; 1×0.15 .
- (c) Main stem, 0.7×0.12 ; 0.45×0.06 ; 0.4×0.05 .
- (d) Anthocodiae, 0.35×0.03 ; 0.3×0.025 ; 0.25×0.02 .
- (e) Tentacles, 0.1×0.01 ; 0.09×0.075 .

In one small colony 60 mm. in height and 30 mm. in breadth the branches arise alternately from the main stem and there is no hint of anastomosis. The polyps stand perpendicularly on two sides and are almost sub-opposite. The ends of the twigs are occupied by two opposite polyps which are protected by some of the spicules of the outer layer of the coenenchyma. The spicules of the outer layer are very large and almost continuous; they are, length by breadth, 4 mm. \times 0.7 mm., 3.8 mm. \times 0.65 mm.; those of the polyps are 0.5 mm. to 0.3 mm. in length. In several respects this small specimen seems to differ from *M. ramosa*, but when we take into consideration the variability displayed we have no hesitation in referring both to the same species.

Localities : Andaman Sea, 53 fathoms ; Persian Gulf, 48-49 fathoms.

Previously recorded from Gulf of Manaar ; off Galle and onwards up West Coast of Ceylon.

Two of the largest colonies in the Wood-Mason Collection belong to this species. The larger is 300 mm. in height and 210 mm. in maximum breadth ; the smaller is 280 mm. high and 110 mm. broad. In external features they closely resemble both the type specimen and the colonies above described, but exhibit the same variations. The large white spicules, standing in relief from the thin fleshy coenenchyma, especially in the smaller branches and twigs, give the colonies a peculiarly characteristic appearance.

***Muricella rubra*, Thomson.**

This species was established for a minute fragment in the Ceylon collection, and as a number of beautiful complete colonies as well as a number of broken pieces were dredged by the "Investigator," we may supplement the original description.

All are of a bright red to orange-red colour ; in length and breadth three colonies are 160 mm. by 120 mm., 110 mm. by 100 mm., and 100 mm. by 45 mm. respectively, while the diameter of the axis at the base is 4 mm., 3.5 mm. and 2 mm.

The branching is confined to one plane and is very irregular. The branches arise at varying angles and bend in diverse directions. The coenenchyma is fairly thin and almost *level*. In the younger portions the spicules are large

and disposed longitudinally. They are not uniform in size, but there does not seem to be any definite mode of arrangement among the larger forms; in some cases these extend from the base of one verruca to that of the next, but often they lie encircling the base of the verrucæ. On the main stem and larger branches the longitudinal arrangement is by no means obvious; there are fewer large spicules and these often lie almost transversely. This feature is very important, especially in the identification of a species from a detached fragment.

There is a marked flattening of the stem and branches in the plane of ramification, but in the younger twigs this often entirely disappears. The axis is horny and slightly flexible; it is brown in colour at the base but yellow in the twigs.

The disposition of the verrucæ is also a character which shows considerable variation. In one specimen the main stem and larger branches are quite devoid of polyps, while in another the surface is irregularly covered with them. On the secondary branches verrucæ occur almost all round, but on the twigs they are crowded on the sides and are sub-alternate; younger forms arise between them and break the otherwise regular contour. The verrucæ are small truncated cones about 0.5 mm. in height and 0.75 mm. in diameter at the base, but when fully retracted they are dome-like; those on the main stem and larger branches are smaller and wart-like. The spicules are smaller than those of the cœnenchyma and are arranged longitudinally; in some places they are grouped in eight bundles with eight projecting points. The base of the verruca is embedded in the cœnenchyma.

The tentacular operculum is only feebly developed; the collaret consists of two or three rows of slightly interlocking, curved spindles, and standing upon this are the eight points, each formed of about four curved spindles arranged "en chevron," but in some cases six or seven are present with no definite arrangement.

The spicules are warty and spiny spindles, straight, curved, or slightly S-shaped, pale red or orange in colour; those of the operculum are colourless and much smaller. The following are some of the measurements length and breadth in millimetres:—

- (a) Cœnenchyma of main stem, 0.45×0.05 ; 0.25×0.025 ; 0.2×0.05 .
- (b) Cœnenchyma of twigs, 0.8×0.1 ; 0.7×0.075 ; 0.5×0.06 ; 0.2×0.05 .
- (c) Verrucæ, 0.45×0.05 ; 0.4×0.045 .
- (d) Tentacular operculum, 0.2×0.03 ; 0.175×0.025 .

Localities: Andamans, 270-45 fathoms; off Ganjam Coast, 18 fathoms.

Previously recorded from the Ceylon Seas.

Muricella rubra, Thomson, var. **robusta**, n.

Two young colonies represent this new variety.

The more complete is 90 mm. in height and 40 mm. in maximum breadth; it is of a purplish-red colour with white polyps. The branching is sparse and is confined to one plane; the branches are more distant than in *M. rubra* and arise more regularly. The verrucæ are alternate and are considerably elongated in the direction of the axis, being also flattened in the plane of ramification. The coenenchyma is thin and has a very even surface, the larger spicules being embedded among the smaller but not projecting beyond the surface. The polyps are white, and when imperfectly contracted stand out in strong contrast; they are densely covered with small transparent spicules arranged transversely. On the aboral surface of the tentacles there are triangular groups each consisting of a large number of spindles with a slightly "en chevron" arrangement. The spicules of the coenenchyma show the same features as to size and arrangement as in *M. rubra*, but here they are much larger.

The following are some of the measurements length and breadth in millimetres :—

(a) Coenenchyma, 1.8×0.2 ; 1×0.15 ; 0.85×0.1 .

(b) Verrucæ, 0.5×0.05 ; 0.45×0.05 .

(c) Polyp, 0.25×0.02 ; 0.2×0.02 .

This specimen shows a marked resemblance to *M. rubra*, but as it differs in the following respects we have named it as a new and distinct variety, *viz.*, *robusta*, n. :—

- (1) The branching is sparse and the branches are more regular and distant.
- (2) The verrucæ are more strictly alternate, more flattened in the plane of ramification, and more elongated in the direction of the axis.
- (3) There is a greater abundance of spicules on the polyps, and the tentacular operculum is better developed.
- (4) The spicules are larger in proportion to the size of the colony.

Localities: Andamans, and Station 78 off Ganjam Coast, 18 fathoms.

A small bright red colony with white anthocodiæ in the Wood-Mason Collection seems referable to this species. It is more bushy than the general type and diverges slightly from the *robusta* variety, being intermediate in several characters.

Muricella arborea, n. sp.

Plate III. figs. 1 and 5; Plate VIII. fig. 18.

This new species is represented by a beautiful robust colony 19 cm. in height and 11 cm. in breadth. The mode of branching differs from other species of *Muricella* and is by no means obvious. The larger branches arise

from two sides of the main stem and extend in one plane almost perpendicularly, but near the top of the colony where the branches are all about the same length, they stand out in equal numbers in two planes at right angles to one another. The main stem as well as the larger branches again bear twigs in four directions, and this adds to the bushy appearance of the colony. The diameter of the main stem is about 3 mm., that of the twigs about 1.25 mm.

The coenenchyma is fairly thick, brown in colour and contains two layers of white spicules. The inner layer is densely packed and the spindles are arranged in all directions. The outer layer is discontinuous, and consists of large rough warty spindles, often slightly constricted at the middle with swellings on either side; these are quite visible to the naked eye and are sometimes 3.5 mm. in length. On the older parts they are disposed irregularly, but on the branches and twigs they occur in three or four longitudinal rows mainly on two surfaces, and so give the appearance of white streaks traversing the whole length of the axis; they often curve and twist around the base of the verrucæ.

On the main stem and larger branches the polyps occur irregularly, young forms arising in no definite manner; on the smaller branches and twigs they generally occur on the lateral surfaces, but encroach on the other two, though directed laterally. The tip of a twig is occupied by two almost opposite polyps with a central dome-like part consisting of the end of the axis covered by the thick coenenchyma. All stages of development are also found on the younger twigs.

The verrucæ are cylindrical when open, dome-like when closed, 1.5 mm. in height and about 1 mm. in basal diameter. The spicules are arranged in a fairly definite manner, and are intermediate in size between those of the two layers of the coenenchyma. At the base they are arranged almost transversely, but passing upwards they become grouped into eight bands with an "en chevron" arrangement, the angle gradually lessening until at the top they are almost longitudinal, in pairs of sheaves. When partially open they display eight triangular points which fit closely together over the wholly retractile anthocodæ.

The tentacles are densely covered on the aboral surface with small spindles. These are arranged "en chevron" at the base, but longitudinally higher up. When the tentacles are infolded they touch on the aboral surfaces, and no definite operculum is formed.

The axis is horny and somewhat flexible; it is blackish-brown in the main stem but paler in the twigs. The general colour of the colony is light brown, but the large spicules appear as white bands.

The spicules are warty spindles, straight, curved, or S-shaped; some of the larger forms from the outer layer of the coenenchyma have a median constriction with a swelling on either side. The following are typical measurements length and breadth in millimetres:—

- (a) Outer layer of coenenchyma, 3.5×0.275 ; 2.5×0.25 ; 2×0.2 .
 (b) Inner ,, ,, 0.35×0.075 ; 0.3×0.05 ; 0.2×0.05 .
 (c) Verrucae, 1×0.175 ; 0.8×0.15 .
 (d) Tentacles, 0.175×0.025 ; 0.15×0.02 .

This new species is quite distinct from other species of *Muricella* in—

- (1) The mode of branching.
- (2) The architecture of the verrucae.
- (3) The nature of the operculum.
- (4) The size and shape of the large outer spicules.

Locality : Arakan Coast, 13 fathoms.

Muricella robusta, n. sp.

Plate V. fig. 8.

Two small colonies of a dusky brown colour, which differ from the usual type of *Muricella* species, seem to be new. The larger is 80 mm. in height and 30 mm. in maximum breadth, and consists of a long main stem from which three lateral branches arise. The smaller is 25 mm. in height and 50 mm. in breadth; the central main stem gives origin to five lateral branches and these in turn bear smaller twigs. Both specimens are characterised by their robustness.

The axis is cylindrical, horny, soft and flexible. It is of a brownish colour.

The coenenchyma is very thick; in the younger portions it is thicker than the diameter of the axis. There are two distinct layers of spicules, an inner layer of very numerous small red spindles, and an outer of larger semi-transparent short and thick warty spindles. The latter are very uniform in size, closely packed but with no definite arrangement. The coenenchyma is very rugose and does not show the interlocking of spicules such as is characteristic of, e.g., *M. rubra*. The exterior recalls the appearance of a spiculose Siphonogorgid.

The polyps display a tendency to a bilateral arrangement, but this is often broken through so that they appear to occur all round. The verrucae are large and conical; they are about 2 mm. in diameter at the base and over 1 mm. in height. The spicules are arranged longitudinally in eight sheaves which pass by gradual transitions into the coenenchymal amature. The anthocodiae are completely retractile, but in many cases the verrucae are contracted so that the polyp appears dome-like on the top. On the aboral surface of the tentacles there is a dense amature of spicules which is very characteristic. Below this there is a distinct crown and point arrangement. The crown consists of three to four rows of curved spindles, and each point is made up of at least three pairs of bent spindles arranged "en chevron"; in many cases there are more. When the polyps

are expanded there is a considerable bare space, between the top of the verruca and the collaret, corresponding to the stomodæal region.

The spicules are mostly spindles; with the exception of the red forms of the inner layer of the cœnenchyma they are colourless. The following are some of the measurements length by breadth in millimetres :—

(a) Cœnenchyma : (1) Red spiny or slightly warty spindles, 0.3×0.04 ; 0.3×0.03 ; 0.2×0.03 .

(2) Spindles covered with minute warts. These are generally very broad and massive. Some are much curved, others are S-shaped; some are scale-like, others are bifurcated, 2×0.4 ; 1.5×0.3 ; 1.4×0.35 .

(b) Anthocodæ : (1) Crown and points, spiny spindles, 0.8×0.1 ; 0.8×0.08 ; 0.7×0.075 ; 0.6×0.05 .

(2) Tentacles, 0.2×0.03 ; 0.15×0.02 .

Locality : Andamans.

GENUS EUMURICEA, Verrill.

Eumuricea splendens, n. sp.

Plate IV. figs. 2 and 3; Plate VIII. fig. 17.

A beautiful pink robust colony, one of the finest in the collection, represents this species. It measures 9.5 cm. in height and 6 cm. in breadth. From a spreading base several main stems arise, but only two of these are perfect, the others being broken off close to their origin.

The branching is confined to one plane, and there is a marked tendency for the branches to arise from one side of the axis. On the largest main stem there are ten branches, seven taking their origin on one side; out of nine on the other stem six arise on the same side. This noteworthy feature also obtains in the case of the secondaries, there being but one exception. Cirripede galls are numerous both on the stem and branches, and these are overgrown with cœnenchyma, which bears polyps.

The axis is horny and flexible and of a golden yellow colour. It is composed of long fibrous strands and is hollow in the centre, presenting a chambered appearance. In reality the cavity is filled with a pulpy mass which seems to be formed into small spherical pellets connected together.

The cœnenchyma is thick except near the base where the yellow axis shines through. It forms the support of the colony and is composed of short thick warty spindles which are arranged for the most part longitudinally but still somewhat irregularly.

The polyps are large and stand out longitudinally. Near the base of the main stem and at the origin of the branches they are disposed mostly on the two sides, but on all other parts they are crowded over the whole cœnenchyma. The verrucæ are prominent and measure 2 mm. in diameter and 1·5 mm. in height. The spicular arrangement is very marked there being eight distinct ridges terminating in eight points. The disposition is almost "en chevron," but the pairs sometimes overlap one another. The walls of the verrucæ are thick and rigid.

The anthocodiæ are completely retractile. When protruded, but with the tentacles infolded, there is a distinct crown and points arrangement, the spicules of the points being arranged in pairs enclosing more and more obtuse angles towards the base, eventually merging into the circlets of curved spindles which form the crown. When the anthocodiæ are retracted the eight projections of the verrucæ close over them, and when partially closed show a beautiful octo-radiate star-like arrangement, the cœnenchyma in the angles being devoid of spicules.

Young polyps occur irregularly among the older ones and around the periphery of the tips of the branches, never on the tips themselves.

The following are the chief types of spicules with some measurements in millimetres :—

(a) Cœnenchyma : Spindles, densely covered with papillose warts sometimes arranged in whorls, red or colourless, $0\cdot8 \times 0\cdot15$; $0\cdot4 \times 0\cdot15$.

More slender spindles with fewer warts, $0\cdot5 \times 0\cdot075$; $0\cdot35 \times 0\cdot05$.

Small irregular forms, somewhat spindle-shaped, $0\cdot15 \times 0\cdot025$.

(b) Verrucæ : Spindles with papillose warts, $0\cdot7 \times 0\cdot1$; $0\cdot75 \times 0\cdot075$ to $0\cdot35 \times 0\cdot15$.

(c) Anthocodiæ : Spiny curved and straight spindles, red in colour, $0\cdot6 \times 0\cdot075$; $0\cdot25 \times 0\cdot04$; $0\cdot2 \times 0\cdot035$.

Another specimen 6 cm. high and 7 cm. broad occurs in this collection but from a different locality. The one-sided method of branching is again prominent, the numbers in this case being six and two. The verrucæ are very closely packed together.

This species bears some resemblance to *E. acervata*, Verrill, with which, however, we cannot identify it.

Localities : Marble Rock, Mergui.

Eumuricea ramosa, n. sp.

Plate VIII. fig. 15.

A new species is required for a huge colony 230 mm. in height and 300 mm. in maximum breadth. The base is expanded in the form of a large cone 28 mm. in diameter and 18 mm. in height. From this the main stem, which is 8 mm. in diameter, arises. It is sinuous and very much contorted and has been broken at a height of 90 mm., the fractured portion being now, however, overgrown with coenenchyma. The branching is predominantly in one plane, but the branches arise irregularly. The larger branches taper markedly, but the twigs are of an almost uniform thickness throughout, except at the tip where many are somewhat clavate.

The axis is horny and rough, being covered with numerous small knobs, presumably the remains of small twigs. It is lamellar in structure and displays a tendency to break up into thin sheets. In one place where a sheet has been partially detached the coenenchyma has completely overgrown the semi-detached portion and formed a flat expansion covered with polyps. The axis is dark brown in colour with lighter longitudinal striations.

The coenenchyma is moderately thin in the main stem and larger branches, and follows the uneven contour of the axis, but in the smaller branches and twigs it is thicker and more uniform. It is densely packed with colourless spicules, which in the older parts are small and irregularly arranged, but in the twigs are disposed longitudinally.

The polyps occur all over the stem, comparatively distant on the older portions, but with their bases almost touching, on the twigs. The anthocodiae are completely retractile and have a distinct tentacular operculum consisting of eight irregular groups of spindles. When partially retracted these form a slightly elevated cone. The verrucae have the form of truncated cones. They are about 1 mm. in height and 1 mm. in diameter at the base. About three may be seen on one aspect in the twigs, but as many as seven in the larger branches where they are comparatively distant. The spicules are arranged longitudinally in eight distinct groups, the tips of the latter forming eight teeth around the oral aperture, within which the tentacular operculum is almost hidden. The tips of the twigs are occupied by three or four polyps at about the same level.

The spicules are for the most part spindles, straight, curved, or S-shaped. Those of the coenenchyma are covered with papillose warts. Many have markedly tapering ends while others are very blunt. In the anthocodiae the spindles are in many cases almost club-shaped, and bear small conical knobs which often diminish in size towards the ends so that the latter portion appears almost smooth. The following measurements length by breadth in millimetres may be taken as typical :—

Cœenenchyma, 1.5×0.175 ; 0.8×0.15 ; 0.6×0.1 ; 0.4×0.075 .

Anthocodiæ, 0.6×0.075 ; 0.4×0.1 ; 0.4×0.05 ; 0.3×0.05 .

The colour of the colony is a greyish white.

Locality : Andamans, 270-45 fathoms.

Family PLEXAURIDÆ.

Plexaura indica, Ridley.

Plexauroides praelonga (Ridley) = (*Plexaura praelonga*, Ridley).

Psammogorgia ridleyi, n. sp.

GENUS PLEXAURA, Lamouroux.

Plexaura indica, Ridley.

Belonging to this species is a very beautiful orange-yellow colony 150 mm. high and 170 mm. broad. It is branched almost in one plane and consists of a main stem 12.5 cm. high from which seven branches arise at intervals of 2 mm. to 6 mm. The main stem arises abruptly from a spreading base overgrown by cœenenchyma. The diameter near the base is 3 mm. and this scarcely diminishes even in the branches, the tips of which are somewhat clavate. The branching is quite irregular, the larger branches giving rise to secondaries in the same way, though there is a tendency in some parts to arise from one side. The angle of origin also varies from 60° to 90° , and all the branches eventually diverge upwards in a sinuous manner.

The cœenenchyma is moderately thick and very rough in appearance. With a low power it is glistening and arenaceous, being uniformly covered with small, smooth, globular projections. It consists of two layers, the outer composed of somewhat club-shaped spicules disposed perpendicularly to the axis, the inner consisting of spicules of very diverse form arranged irregularly. In several places, especially between the polyps, there are marked ridges formed by segregations of spicules.

The polyps are scattered over the whole surface, the verrucæ being inconspicuous. They are separated by distances of about 0.5 mm. and have elongated mouth openings. The anthocodiæ are small, white and wholly retractile. When partially withdrawn the infolded tentacles present an eight-rayed figure which eventually disappears when the walls of the verrucæ close together.

The axis is horny and cylindrical. The colour varies from brown at the base to a pale yellow in the twigs. It is composed of irregular longitudinal strands which in the younger portions present a very pretty variegated appearance. The core is soft and white and is divided into chambers by horizontal partitions.

The spicules of the outer layer of the cœenenchyma are distinct in having a globular expansion which projects on the surface, but the part embedded in the

coenenchyma varies considerably. The globular expansion is generally smooth, but forms with a few warts occur, while in others radial striations which disappear towards the circumference are not uncommon. The following are a few of the types with measurements in millimetres :—

(a) Warty spindles in which one-half is replaced by a smooth globular expansion, 0.22×0.1 ; globular part, 0.1×0.1 .

0.25×0.15 ; „ „ 0.15×0.15 .

(b) Similar to (a) but with the warty spindle part bearing two or three branches, 0.2×0.12 ; 0.22×0.13 .

(c) Similar to (b) but with a further development of warty branches, 0.2×0.18 ; 0.18×0.16 .

Those of the inner layer are :—

(a) Spindles with tuberculated warts, 0.4×0.1 ; 0.25×0.1 .

(b) Warty crosses with characteristic x-shaped marking, 0.3×0.3 ; 0.25×0.2 .

(c) Irregular warty crosses, 0.22×0.1 ; 0.3×0.15 .

There are also minute crosses, 0.1×0.1 , and spiny spindles, 0.2×0.03 , but these are not so numerous.

There are a number of small *Ophiuroids* attached to the branches.

Locality : Andamans. Marine Survey.

Previously recorded from Mergui.

GENUS PLEXAUROIDES, Wright and Studer.

Plexauroides praelonga (Ridley). Plate IX. fig. 13.

= (*Plexaura praelonga*, Ridley).

A somewhat damaged colony devoid of coenenchyma in several places. It is 120 mm. in height and 70 mm. in maximum breadth. The growth is approximately in one plane, but fusion has occurred between this colony and part of another, so that an irregular mass results. The branching is irregularly dichotomous. The diameter of the main stem is about 2.75 mm. The axis is horny, hard and black in colour : it has a diameter of 2.25 mm. at the base.

The coenenchyma is moderately thick and presents a peculiar appearance. The spicules of the outer layer have a projecting thin, smooth, foliaceous expansion. These slightly overlap and give the characteristic structure. On the verrucae similar spicules are arranged circumferentially.

The polyps are numerous and are closely but irregularly disposed on the stem and branches. The verrucae are slightly elevated and give the surface an undulating contour. The distance between the centres of any two varies from 1 to 1.75 mm., but young forms occur irregularly among the larger and more mature polyps. The anthocodiae are completely retractile. The tentacles are

first infolded and then the whole is withdrawn. There is a distinct collaret of two to three rows of curved spindles surmounted by eight triangles. Each triangle is formed by two long, slightly curved spindles, touching for a short distance on their convex sides and based by a smaller almost straight spindle.

The general colour of the colony is almost brick-red but the polyps are white.

The spicules of the general cœnenchyma are red but those of the anthocodiæ are colourless. The following are the more typical forms with measurements in millimetres:—

- (a) Cœnenchyma; (1) Foliaceous clubs. From one end of a thick central shaft there extend one to three irregularly warty projections and from the other a foliaceous expansion. The latter is variously shaped and thins off towards the edge. In some cases it is perfectly smooth but in others a few warts occur. Dimensions, 0.6×0.3 ; 0.5×0.4 ; 0.4×0.35 ; 0.25×0.2 .
 (2) Warty spindles which are sometimes branched, 0.5×0.1 ; 0.4×0.1 ; 0.3×0.08 ; 0.2×0.06 .

(b) Anthocodiæ: Small thick spiny spindles, 0.2×0.025 ; 0.15×0.02 .

This species approaches very closely to Ridley's variety *cinerea*.

Locality: Andamans.

Previously recorded from Port Curtis, Queensland, 5-10 fathoms, Ridley; Torres Straits, Wright and Studer ("Challenger").

GENUS PSAMMOGORGIA, Verrill.

Psammogorgia ridleyi, n. sp.

Plate II. fig. 5; Plate IX. figs. 10 (a), 10 (b).

This species is represented by a beautiful upright colony 26.5 cm. high and 12 cm. in breadth. It is attached to a piece of rock over which there spreads a thin filmy base covering cirripedes and madreporal coral. From this reptant base there arise two conical structures which give origin to two main stems. The smaller of these is 14 cm. high and gives off branches on two sides in one plane. This colony is devoid of cœnenchyma and is overgrown by a sponge. The larger, which constitutes the diagnostic specimen, is branched almost in one plane. Only one branch diverges, and it ultimately converges to the plane of ramification. Secondary branches arise in the same manner from the primaries. The tips of the branches and twigs are slightly club-shaped. The main branch has been broken, and 70 mm. at the tip have been re-grown, but with a smaller diameter.

The colour is a light brown with dark parts around the polyps due to the thinness of the spicular covering.

The cœnenchyma is thin near the base but thick in the smaller twigs, eventually producing swellings at the tips. It is densely packed with warty spicules. The longitudinal nutrient canals are evident on dissection, their walls bear longitudinally arranged very minute spindles.

The polyps are scattered over the whole surface and appear as dark pits, being sunk within the cœnenchyma when retracted. The verruca-opening is elongated in the direction of the axis, measuring 1.25 mm. in length and 0.5 mm. in breadth. They are separated by distances of about 0.5 mm. and give the surface a markedly pitted appearance. The anthocodiæ are wholly retractile. When the tentacles are infolded they form an eight-rayed, star-like, almost horizontal tentacular operculum which becomes hidden by the closing of the verrucæ.

The axis is horny and fibrous. It is of a bright golden colour with darker streaks due partly to the fibrous structure and partly to the refraction of light.

It is very flexible and has a soft, pulpy, white core. It measures 2.5 mm. at the base and diminishes gradually to a hair-like fineness at the tip.

The spicules present the following types with measurements in millimetres :—

(a) Spindles, thick, markedly tapering and densely covered with tuberculate warts, 0.3×0.075 ; 0.25×0.05 ; 0.2×0.04 .

(b) Spindles with warts in four or five whorls and warted ends, 0.2×0.025 ; 0.15×0.02 .

(c) Thick densely warted spindles with blunt ends, 0.12×0.05 ; 0.175×0.075 ; 0.1×0.075 ; 0.2×0.075 .

(d) Spindles irregularly covered with warts, 0.15×0.03 ; 0.175×0.02 .

(e) Quadri-radiate forms with a distinctly x-shaped marking, 0.12×0.12 ; 0.1×0.1 .

(f) Quadri-radiate forms with arms at right angles—with a distinct cross, 0.15×0.075 ; 0.15×0.065 .

(g) The spindles of the anthocodiæ are spiny spindles, 0.1×0.01 ; 0.12×0.01 ; 0.15×0.01 .

Locality : Andamans (G. H. Booley).

Family GORGONIDÆ.

GENUS LOPHOGORGIA, Milne-Edwards.

Lophogorgia lutkeni, Wright and Studer.

Belonging to this species there is in the collection a beautiful almost brick-red specimen, incomplete at the base, 170 mm. in height and 110 mm. in breadth.

It is expanded in one plane and consists of a main stem which bifurcates at a distance of 40 mm. from the broken end. One of these two main branches again divides dichotomously after a distance of 40 mm., but the other extends to the top of the colony. On the latter the simple branches, seven in number, seem to arise all from one side, but this appearance is in reality due to a twisting of the axis. On one of the tertiary branches two twigs arise together near the tip and are bound for a short distance by the fusion of the cœnenchyma, but they eventually diverge.

The branches are slightly flattened in the plane of ramification. They vary very little in diameter but are slightly conical at the tip.

The cœnenchyma is fairly thick and is marked by a deep longitudinal groove which extends on each of the two surfaces in the plane of ramification. These are due to the collapse of the large nutrient canals. They are very sinuous and sometimes appear to ascend in a spiral, owing to a twisting of the axis. In some places this feature is so marked and the depressions are so deep that a cross section of a branch appears like two circles overlapping on a short common chord.

The polyps are disposed in two irregular rows on each side of the stem and branches. They are completely retractile within the cœnenchyma and appear as elongated depressions or slits, showing an octo-radiate figure which is visible even to the naked eye.

The axis is extremely calcareous and is of a pale yellow colour; it is cylindrical and presents a rough appearance on the surface.

The spicules are spindles with generally four to six whorls of rough warts. The whorls are about equidistant, but sometimes the two middle whorls are separated by a greater distance than the others, so that the spicules approach the type known as "double-spindles". They have the following measurements, length by breadth in millimetres:—

0.13×0.05 ; 0.12×0.05 ; 0.11×0.04 ; 0.08×0.03 ; 0.07×0.04 ; 0.065×0.035 ; 0.05×0.03 ; 0.045×0.025 ; 0.04×0.03 .

Locality: Andamans.

Previously recorded from Prince Edward Island, 310 fathoms ("Challenger"); Cheval Paar, Gulf of Manaar (Herdman's Collection).

Family *GORGONELLIDÆ*.

Nicella reticulata, n. sp.

„ *pustulosa*, n. sp.

Juncella racemosa, Wright and Studer.

Verrucella flexuosa, Klunzinger.

Gorgonella umbella, Esper.

„ *granulata*, Esper.

GENUS NICELLA, Gray.

Nicella reticulata, n. sp.

Plate IV. fig. 5; Plate VIII. fig. 12.

Over a dozen specimens of peculiar colouration represent this species. A typical colony measures 27 cm. in height by 16 cm. in maximum breadth, and is attached by a very much broadened expansion. It consists of a main stem only 2 cm. long and measuring 4·5 mm. in diameter. At the distal end of the main stem four branches arise, two sub-opposite and two at slightly different levels, but all very close together. These diverge at varying angles, the two lower being almost horizontal, the other two also in the same plane of ramification. These ramify irregularly in one plane and anastomose freely, forming a large almost semicircular flabelliform mass with very irregular meshes.

The coenenchyma is thin and compact, and presents a glistening arenaceous appearance. The colouring is very peculiar, being generally reddish-brown in the lower part of the colony, gradually merging into slaty-grey in the upper parts. Patches of grey appear throughout the red in some of the colonies and *vice versâ*, while one colony from the Laccadives is almost of a uniform brick-red colour. The surface bears longitudinal furrows which are sinuous and sometimes almost spirally twisted, one being generally deeper than the others. These extend into the secondary branches and even into one side of the twigs; the number diminishes with the size of the branches.

The axis is very calcareous and cylindrical in form. It has an almost olive-green colour at the base, gradually merging into a pale yellow in the smaller branches.

The polyps are disposed in a very indefinite manner. They are chiefly lateral on the main stem or primary branches; in the secondary branches they are arranged almost all round. On the finer branches and twigs they occur for the most part on two sides, but this rule is broken occasionally by the occurrence of polyps on all the four sides. The verrucae are dome-like but slightly flattened on the twigs. They are separated by intervals of about 1 mm. in the branches, but their bases touch on the branchlets and give an undulating appearance. They measure about 0·5 mm. in height and 1 mm. in diameter. When the verruca closes over the retracted polyp an eight-rayed star is formed by the eight lobes of the wall. The anthocodiae are very minute and are completely retractile, the spicules being arranged transversely on the tentacles.

The spicules of the coenenchyma are small, warty, and very diverse in form. The following are a few of the more common types with measurements in millimetres :—

(a) Double-clubs with smooth warts :—

0.05 × 0.04 ; constriction, 0.02 broad × 0.008 long.

0.048 × 0.04 ; „ 0.02 „ × 0.005 „

(b) Double-clubs with fewer and more irregular warts :—

0.06 × 0.04 ; constriction, 0.03 broad × 0.01 long.

0.048 × 0.035 ; „ 0.02 „ × 0.012 „

(c) Spindles with round warts and having a smooth part in the middle :—

0.09 × 0.025 ; smooth part, 0.02

0.085 × 0.028 ; „ „ 0.018

(d) Minute crosses with a very distinct x-shaped marking, 0.04 × 0.04.

(e) Minute irregular crosses, elongated along one diagonal, with distinct x-shaped marking, 0.05 × 0.03.

Those of the tentacles are short warty rods, 0.05 × 0.015 ; 0.06 × 0.015.

Localities : Persian Gulf, 48-49 fathoms ; Laccadives, 30-50 fathoms.

Another portion of a colony in the Wood-Mason Collection must also be referred to this species in the meantime. It is 95 mm. in height and 35 mm. in breadth. The colour of the coenenchyma is almost vermilion-red but in the twigs it fades away until it is creamy-white. The verrucae are distinct and dome-like—a feature of little importance. The spicular characters are like the above.

Nicella pustulosa,¹ n. sp.

Plate V. fig. 6 ; Plate VIII. fig. 11.

A small colony of a brownish-yellow colour, 80 mm. in height and 40 mm. in breadth, branched, though not exclusively, in one plane. The branching is irregular but in some places it is sub-alternate. The branches arise almost perpendicularly, but after a sweeping curve turn upwards and run sub-parallel to the main stem. The twigs terminate in a small knob on either side of which there stands a diverging polyp.

The coenenchyma is moderately thick and presents a much sculptured and ridged appearance, almost reticulate in the older portions (*cf. Suberogorgia ornata*, n. sp.). This feature is doubtless due in part to contraction and appears even in the verrucae. The whole surface is glistening and arenaceous.

¹It is with some hesitation that we refer this type to the genus *Nicella*. It is a matter of no small difficulty to distinguish between *Nicella*, *Gorgonella* and *Verrucella*. Distinctions based on spicules alone are very unsatisfactory in this group because the spiculation varies at different levels and transition forms are so numerous and varied that it is sometimes almost impossible to distinguish between double-spheres, double-stars and double-clubs, each in turn passing gradually to double-spindles. In *Verrucella*, however, the axis is lamellar and there are double-stars ; in *Gorgonella* the axis is lamellar and radially striated and double-spheres occur. Our specimens approach *Nicella* in several respects though agreeing with none of the described species, and as the positive characters of the other genera are absent, we feel justified in making a new species to include these forms.

The polyps are disposed over the whole circumference, but in the main stem there is a bare space on each of the flattened surfaces, interrupted in a few places by an occasional young polyp. The verrucæ are about 1 mm. in height and 1 mm. in diameter. They are cylindrical and bear distinct ridges and furrows; they present a stellate structure at the tip. They are more orange in colour than the rest of the coenenchyma, but the ridges are lighter and stand out in marked contrast.

The axis is calcareous but more densely near the periphery than in the core, and much more so in the twigs than in the older portions. It is not lamellar in structure, but appears almost as if sclerogorgic. The surface is smooth and glistening.

Several fragments also occur from the Laccadives. The branching is predominantly in one plane, but one branch arises perpendicular to this plane and gives off twigs, so that the whole stands at right angles to the original plane of ramification. The specimens are paler in colour than the colony above described, but show the same ridging, which is visible even to the naked eye. The polyps are disposed in a close spiral and are about 1.5 mm. in height. The verrucæ are cylindrical, ridged and furrowed, and have a depression at the oral aperture.

The spicules are typical of the group to which this genus belongs. The following are the chief types with measurements length by breadth in millimetres :—

(a) Thick warty spindles with very rugose ends and the warts in irregular whorls, 0.08×0.03 ; 0.08×0.02 ; 0.06×0.03 ; 0.07×0.025 .

(b) Irregularly warted spindles, 0.06×0.025 ; 0.05×0.0175 ; 0.05×0.02 .

(c) Double clubs with a very narrow constriction, 0.07×0.04 ; 0.06×0.03 ; 0.05×0.03 .

(d) Small double-clubs, 0.03×0.02 .

(e) Double-spindles, 0.07×0.025 ; 0.06×0.02 .

(f) Crosses with a very distinct x-shaped marking, 0.06×0.05 ; 0.04×0.04 .

Localities: Andamans; Laccadives, 30-50 fathoms.

GENUS JUNCCELLA, Valenciennes.

Juncella racemosa, Wright and Studer.

(= *J. miniacea*, Thomson and Henderson.)

There occurs in the Wood-Mason Collection a small portion of a colony 40 mm. in height and 25 mm. in breadth which agrees closely with the above species. The main branch gives off five smaller branches on one side and one on the other, so that the colony has a unilateral appearance. Two of these branches also give rise to fine twigs.

The verrucæ are crowded and disposed all round with no apparent order ; they are over 6 mm. in height and curve upwards and inwards close to the branch ; they exhibit an eight-rayed star at the apex. The coenenchyma is moderately thin and presents an even surface. The axis is slender and pale yellow in colour. The spicules agree with those of the type specimen.

The figure of the spicules of this species given in the "Challenger" Report does not give a true appreciation of their form, and this led Thomson and Henderson to establish the new species *J. miniacea*, but an examination of the type specimen in the British Museum shows that the latter species is not distinct. The long spindles of *J. miniacea* are unfortunately extrinsic.

Note on Genus Juncella.

The system of classification which at present obtains with regard to the *Juncella* group of Gorgonellids, including *Juncella Ellisella*, *Scirpearia* and *Scirpearella*, is far from satisfactory ; in fact, it is a debatable question whether these should be ranked as separate genera.

Many of the species which have from time to time been described have undoubtedly been established on young colonies, and in addition to this the characters which are taken as diagnostic, *e.g.*, arrangement and retractility of verrucæ, vary so much in individual specimens that little or no importance can be attached to them.

We have, in our possession, a large number of colonies from the Indian Ocean in addition to those in this collection, but at present do not feel justified in referring these to any existing species. At the same time we refrain from multiplying species without some sound basis of classification. This we hope to supply in a subsequent study. For this reason we submit a table (at the end of the text) of the various specimens in this collection.

GENUS VERRUCELLA, Milne-Edwards.

***Verrucella flexuosa*, Klunzinger.**

Plate IV. fig. 10.

This species seems to us to be very variable. In the collection there are a number of specimens in which the spiculation is essentially the same, but the external appearance is so different in the various forms that, on macroscopic examination alone, one would feel almost justified in ranking them as distinct varieties if not species. These differences, which are so pronounced, may, in part, be due to the mode of killing and consequent contraction. Instead, therefore, of adding to the present list of varieties by placing in undue prominence characters of doubtful taxonomic importance, we refer all the specimens to the species

V. flexuosa and draw attention to such points as seem most variable, *e.g.*, mode of branching, colour, nature of surface of cœnenchyma, prominence and shape of verrucæ, etc. It is worthy of note with reference to this species that Klunzinger says that anastomosis is exceptional whereas in (A) it is extremely abundant.

The following are some of the more important types :—

(A) Several broken specimens of a beautiful *orange-red* colour, the largest 80 mm. in height and 130 mm. in maximum breadth, may be grouped together. The branching is irregular, and as no basal portion is present it is impossible to detect in what direction the main branches extend. It is distinctly in one plane, and there are abundant anastomoses forming a loose network.

A very remarkable feature is the presence of an enormous number of cirripede galls overgrown with polyp-bearing cœnenchyma, leaving only a small opening for the protrusion of the appendages of the crustacean. There are no fewer than twenty-nine in the specimen of which the measurements are given.

The largest branch measures 2·5 mm. in diameter but the average is about 1·25 mm.

The cœnenchyma is thick and very densely packed with minute spicules. The colour varies in the different specimens from an orange-red to a dull brown, due to the variable colour of the thin outer layer of double-clubs.

The polyps are disposed irregularly on all sides and are numerous on the cirripede galls. The size and shape of the verrucæ depend on the stage of retraction. When fully expanded they are almost cylindrical, 1·25 mm. long and 1 mm. broad, with eight very prominent tooth-like lobes, around the periphery. The anthocodiæ are completely retractile. The tentacles are first in-folded, the lobes subsequently coming together and forming an eight-rayed star. On further invagination this disappears and the verruca assumes a dome-like form 1 mm. in height and 1·25 mm. in diameter with a uniformly granular surface.

The axis is cylindrical, very calcareous and of a pale yellow colour. Where anastomosis takes place the two axes completely fuse together.

The spicules are (1) well-developed double-clubs; (2) transitions to double spindles; and (3) spindles. They are characterised by smooth, blunt warts, and have the following measurements in millimetres :—

(a) Large red double-clubs of the outer layer :—

$0\cdot065 \times 0\cdot05$; constriction, 0·03 broad and 0·007 long.

$0\cdot067 \times 0\cdot05$; „ 0·03 „ „ 0·0075 „

(b) Colourless double-clubs :—

$0\cdot065 \times 0\cdot035$; constriction, 0·02 broad and 0·005 long.

$0\cdot06 \times 0\cdot035$; „ 0·02 „ „ 0·007 „

(c) Smaller colourless and red double-clubs :—

$0\cdot05 \times 0\cdot03$; constriction, 0·018 broad and 0·067 long.

(d) Transitions to double-spindles, the bare space becoming smaller and smaller, eventually merging into spindles :—

0.06×0.02 ; 0.06×0.015 ; 0.07×0.015 ; 0.07×0.02 .

(e) Very few tetra-radiate forms with distinct x-shaped marking :—

0.07×0.03 ; 0.035×0.03 .

(f) Small spindles of the tentacles with few warts in 2 whorls :—

0.035×0.01 ; 0.03×0.009 .

Locality : Andamans.

(B) A small complete colony, 45 mm. in length and 30 mm. in breadth, also two fragments 40 mm. \times 12 mm. and 30 mm. \times 30 mm. in length and breadth respectively. They are expanded in one plane, and the branches arise almost at right angles and maintain their original course. They are flattened slightly in the plane of ramification. The cœnenchyma is finely granular and glistening when viewed under the lens, resembling in many ways a fish roe. The surface is comparatively smooth. The polyps occur all round and are completely retracted so that the verrucæ appear as slight undulations on the otherwise even surface. In one of the specimens, however, the verrucæ appear as truncated cones and attain a height of almost 1 mm. The colour is *dull brick-red*.

Locality : Andamans, 270-45 fathoms.

(C) Several small fragments, the largest of which is 70 mm. in height and 50 mm. in breadth. The branching is essentially in one plane, but by unequal growth this is sometimes not evident. The branches arise at various angles and are slightly sinuous. The cœnenchyma is moderately thick and presents a glistening arenaceous appearance. The verrucæ occur all over the cœnenchyma and stand out in relief as low domes.

The anthocodiæ are completely retracted. There is a faint trace of a bare space on the flattened surfaces, but this feature is here and there broken through by an intruding polyp. On the top of the verrucæ there is a distinct pit, but no trace of a stellate structure is discernible. It is noteworthy that the tips of some of the twigs are almost perfectly smooth, showing that the polyps may be retracted almost to the level of the cœnenchyma. The colour is *ochreous-yellow*.

Locality : Andamans, 270-45 fathoms.

(D) A number of portions of colonies. One of these is 55 mm. in height and 25 mm. in breadth, and consists of a branch from which several twigs arise at considerable intervals almost perpendicularly. The cœnenchyma is moderately thick and has an almost even granular surface. The polyps are disposed irregularly around the circumference. The verrucæ appear as truncated cones slightly over 1 mm. in height. The tips are paler in colour than the lower portion, which corresponds in colour to the cœnenchyma. On one of the twigs we find all stages of retraction from truncated cones 1 mm. in height to an almost inappreciable undulation at the tip. The colour of the cœnenchyma is *yellow with*

a salmon-pink tinge, but the top of the partially retracted verruca is almost pale yellow.

Locality ; Andamans, off Rutland Island, 35 fathoms.

(E) Several delicate fragments the largest of which is 45 mm. in height and 20 mm. in breadth. The diameter of the largest branch is 1.5 mm.

The coenenchyma is thin and comparatively smooth. The branching is in one plane and most of the branches arise almost perpendicularly. The polyps are disposed all round, but mainly on three surfaces. The verrucæ appear as truncated cones with a terminal depression. They have a height of over 1 mm., *i.e.*, almost equal to the thickness of the branch on which they are borne. They have a diameter of 0.75 mm. The colour is *brownish-yellow* but the tips of the verrucæ are almost white.

Locality : Andamans, 270-45 fathoms.

(F) A number of broken portions of a large colony all with a distinct tendency to branch in one plane. The branches arise at right angles, are very closely packed together and considerably thinner than those from which they arise. The coenenchyma is thin, glistening and arenaceous. The polyps occur all round and show all stages of retraction from elongated truncated cones to small dome-like elevations. The colour is almost *brick-red*.

Locality : Andamans, 270-45 fathoms.

(G) A large slightly damaged branch, 95 mm. in height and 45 mm. in breadth. It gives off branches for the most part from one side, and these bear slender twigs. The diameter of the main stem is 4 mm., that of a twig 1 mm. The coenenchyma is thin and comparatively smooth. The polyps occur all round. On the main stem they appear as small warts, but on the twigs they are more elevated, and in proportion to the diameter are much more conspicuous. The colour is a *pale greyish-yellow*.

Locality : Andamans, 36 fathoms.

Several specimens in the Wood-Mason Collection represent this species. The first and largest is orange-red in colour ; it is 150 mm. in height and 210 mm. in maximum breadth, so that the expansion is much more lateral than vertical. The verrucæ occur all round and are large and distinct. The specimen is quite typical of the species. The other colonies have a dull orange-brown colour.

GENUS GORGONELLA, Valenciennes.

Gorgonella umbella, Esper.

= *Gorgonia umbella*, Esper ; see Ridley, "Alcyonaria of Mergui Archipelago," "Journ. Linn. Soc.," xxi. (1887), p. 240. Plate VIII. figs. 8 and 10.

Belonging to this species there are specimens from three different localities. One small broken colony 90 mm. high and 30 mm. broad is interesting chiefly

from the fact that it still retains its main stem and expanded disc of attachment. The main stem is 6 mm. in diameter near the base, which is dilated and forms a truncated cone with a maximum diameter of 1.2 cm. At a distance of 6 mm. from the attached portion the stem divides into two almost equal branches which diverge at slightly different angles. In the other specimens, which are more complete in many ways, the principal stem has become detached. The largest of these is 180 mm. high and 120 mm. broad, and bears several diverging branches slightly larger than the others.

Branching occurs on the larger and also on the secondary branches at very short intervals. It is strictly confined to one plane so that the whole colony is flabellate in appearance. The branches are sub-parallel, arising nearly perpendicularly but mostly diverging upwards. Anastomoses are abundant giving great rigidity to the colony. The axes are completely fused and the branches scarcely exceed 5 mm. without becoming attached to others. Into the meshes of the network so formed short branches about 3.5 mm. to 4 mm. in length project, and it is possible that these young branches will ultimately fuse with the others, forming a denser and denser colony as growth proceeds.

The coenenchyma is very thick and finely granular in appearance, being densely packed with warty spicules.

Polyps occur on all sides of the stem and branches except near the base of the main stem where they become sparse and finally leave a bare space. The verrucæ vary in size and shape, but no type is restricted to any special portion of the colony. Some are truncated cones measuring 1 mm. in height, others are lower and more dome-like, while some scarcely protrude beyond the level of the coenenchyma. When they are closed over the retracted polyp there remains a small circular opening surrounded by an eight-rayed star formed by the inturned lobes of the margin. The anthocodæ are very minute and are completely retractile. The tentacles are colourless and when infolded are guarded by eight pairs of long transparent spicules, each pair enclosing an acute angle; the points project beyond the base of the tentacles.

The colour of the colony is chocolate-red.

The spicules are yellow in colour and include the following types with measurements in millimetres:—

(a) Warty spindles, 0.08×0.02 ; 0.075×0.03 .

(b) Spindles with the warts in whorls, 0.07×0.03 ; 0.05×0.03 .

(c) Double-clubs, 0.06×0.04 , constriction 0.02.

0.06×0.03 , „ 0.02.

(d) Transitions to spindle-shaped (warty), 0.08×0.03 ; 0.085×0.02 .

(e) Warty crosses with a very distinct x-shaped marking, 0.05×0.05 ; 0.04×0.04 .

Localities : (1) Off Ganjam Coast, 10 fathoms ; (2) Puri, 10 fathoms, Rocky Bank ; (3) S.W. Cape Comorin, 2-3 miles, 38 fathoms.

Previously recorded from Mergui (Ridley), probably Bay of Bengal (Esper).

Gorgonella granulata, Esper.

= *Gorgonia granulata*, Esper. Plate VIII. fig. 9.

There is not much positive content in Esper's original description of this species, *e.g.*, "fulvescent cortex with granular pores, some nearly hemispherical others almost concealed," but as there is a strong resemblance between our specimen and Esper's figure of *G. granulata*, we have resuscitated the latter, amplifying the original description by including details of spiculation, etc.

A small much-damaged colony of a yellowish-brown colour, 70 mm. in height and 40 mm. in breadth. The branching is in one plane and no hint of anastomosis is to be seen. The whole colony is stiff and rigid, and the majority of the branches come off almost perpendicularly. The diameter of the main stem is 3 mm., and throughout the colony the diameter of the branches varies only very slightly, except near the tips where they are conical.

The axis is densely calcareous and very hard ; it is made up of concentric laminae and is radially striated. In the older portions it has an olive-green tint, passing through a pale brown in the branches to almost white in the twigs.

The coenenchyma is moderately thick and consists of two to three layers of spicules. The surface is very even and is glistening and arenaceous in appearance. In several places cirripede galls occur, but these are quite overgrown by polyp-bearing coenenchyma.

The polyps are scattered irregularly over the whole colony. There are very small verrucae which hardly project beyond the surface of the coenenchyma but give it a slightly undulating contour.

The spicules are typical of the genus except that the double-spheres are not much in evidence and merge insensibly into double-clubs. The following are the more important types with measurements length by breadth in millimetres :—

(a) Double-spheres, 0.07×0.04 ; 0.06×0.03 .

(b) Double-clubs with very irregularly warted ends and a short constriction, 0.07×0.04 —constriction 0.02 ; 0.06×0.04 —constriction 0.02.

(c) Double-clubs with a warty projection at each end and a single whorl of warts on either side of the constriction, 0.06×0.04 ; 0.06×0.035 .

(d) Double-spindles, markedly tapering and very warty, 0.08×0.03 —constriction 0.02.

(e) Warty spindles, 0.06×0.02 ; 0.05×0.015 .

Locality : Andamans.

Previously recorded from China Sea (Esper).

To this species we also refer a much battered specimen in the Wood-Mason Collection. It is 180 mm. in height and 40 mm. in breadth. It is pale brown in colour; much of the cœnenchyma has been rubbed off and many of the twigs have been broken. The cœnenchyma is extremely thin and evenly disposed. The verrucæ are small and dome-like and give an undulating appearance to the twigs where they are disposed for the most part laterally and alternately. The spiculation is essentially the same as the above.

ORDER V. STELECHOTOKEA, Bourne.

SECTION I.—ASIPHONACEA.

Family *TELESTIDÆ*.

GENUS TELESTO, Lamouroux.

Telesto arborea, Wright and Studer.

This species is essentially a shallow-water form, as indeed are nearly all the representatives of the genus, the only exception being *Telesto arthuri*, Hickson, which is recorded from 232-430 fathoms in the Indian Ocean. All the specimens of this species collected by Crossland around Zanzibar were found in shallow water under 10 fathoms, and the type specimen in the "Challenger" collection was dredged at a depth of 49 fathoms.

The collection includes numerous colonies, from four different localities. Some of them attain a length of 235 mm. Those from the Andamans are of a dark brown colour, but the others are creamy-white to yellowish. They agree with the description given by Wright and Studer, but in some cases the polyps are larger—the verrucæ sometimes measuring 6 mm. while those with the tentacles simply infolded attain a length of 9 mm. The spicules are essentially as described, but many of the spindles have the warts more densely packed. From the eight ridges on the verrucæ prominent bands of spicules extend along the aboral surface of the tentacles. When the tentacles are infolded the bands of spicules form a distinct eight-rayed star.

It is interesting to note the number of epizoic animals found on almost all the specimens. Many are covered by an encrusting monaxonid sponge which quite obliterates even the contour of the colony. Groups of acorn-shells are very common and young pearl oysters are of not infrequent occurrence. Various Ophiuroids are also seen clinging to the larger stems, while small Polychæts have burrows between the encrusting sponge and the colony.

Localities : Andamans, Marine Survey, 270-45 fathoms ; southern portion of Malacca Strait ; Gaspar Straits ; East Coast of Sumatra ; Karachee.

Previously recorded from the Arafura Sea, 49 fathoms ; also from Zanzibar, 10 fathoms.

Several fragments in the Wood-Mason Collection, the largest of which is 65 mm. in length, undoubtedly belong to this species. They are coral-red in

colour but are partly overgrown by a white spongy growth. The verrucæ are large and cylindrical and are disposed in irregular spirals; the anthocodiæ are white and retractile.

***Telesto rubra*, Hickson.**

This species is represented by a number of fragments of a bright coral-red colour, one of which has a basal attachment on a piece of rock overgrown by Polyzoa. The largest is 70 mm. in height. The diameter of the main stem is 3 mm., that of the branches 1 mm.

The polyps are borne in irregular spirals, those on one side being about 3 mm. apart. The verrucæ vary in height from 1 to 2.5 mm. The anthocodiæ are white and are completely retractile; they contain numerous small colourless spicules. When contracted they display an octo-radiate stellate structure. The axial portion, though apparently composite, does not disintegrate on boiling. At the ends of the verrucæ, when the polyps are partially retracted, individual spicules occur in eight groups meeting in the centre and forming a cone; these bands are the continuation of eight ridges on the hollow tubes. The spicules agree with those of the type specimen.

Locality: Off Rutland Island, 35 fathoms; Andamans, 270-45 fathoms.

Previously recorded from Maldivé Islands, 23-25 fathoms; and Trincomalee.

***Telesto trichostemma*, Dana.**

In the Wood-Mason Collection there is a small terminal twig of a *Telesto* colony which we refer to the species *trichostemma*. It is 70 mm. in length and is of a cream-white colour; it agrees in great detail (*e.g.*, as to form and dimensions of spicules) with the description given by Wright and Studer in the "Challenger" Report on Alcyonaria. See also Thomson and Henderson, Alcyonaria, in "Ceylon Pearl Oyster Report".

SECTION II.—PENNATULACEA.

Family *KOPHOBELEMNONIDÆ*.

GENUS *KOPHOBELEMNON*, Asbjörnsen.

***Kophobelemnon intermedium*, n. sp.**

Plate I. figs. 1 and 3.

A beautiful colony of a creamy-white colour, flattened in one plane with bilateral symmetry, so that the pro-, meta- and para-rachidial surfaces are easily distinguished. The following are some of the measurements in millimetres:—

Total length of colony	.	.	.	68
Length of rachis	.	.	.	38
Breadth of rachis	.	.	.	4
Length of stalk	.	.	.	30
Breadth of stalk	.	.	.	2

The axis extends the whole length of the colony; it is quadrangular in section and concave on all the four surfaces. The polyps are disposed in a single irregular row on each side and are separated by about 4 mm. They are blue in colour and when retracted shine through the thin cutis. The tentacles are about 2.25 mm. long and bear a single row of bluish-brown pinnules varying in number. The zooids are abundant and fill up most of the interspaces between the polyps. They occur in sinuating rows, are of a dark brown colour, and are easily seen with the naked eye.

The rachis has a glistening appearance due to the hyaline spicules which are arranged longitudinally and are grouped more closely around the polyps, forming pseudo-calyces. The polyps are quite devoid of spicules. The zooids are enclosed in diamond-shaped meshes formed of shorter spicules more densely packed. The stalk is cylindrical with a small swelling near the base. It is finely granular in appearance, the cutis being packed with small spicules which are, however, absent in the interior.

The following are some of the measurements of spicules in millimetres:—

(a) Rod-like plates, some with regular ends, others more indented, 0.35×0.1 ; 0.3×0.08 ; 0.2×0.1 .

(b) Spindles, 0.4×0.075 ; 0.35×0.05 ; 0.2×0.05 ; 0.2×0.03 .

(c) Spindles with bifurcated ends (the bifurcations sometimes attaining a length of 0.1 mm.), 0.4×0.05 ; 0.35×0.05 ; 0.2×0.04 .

Locality: Gulf of Martaban, 53 fathoms.

Note on Position of Kophobelemnon intermedium, n. sp.

The specimen, for which this new species is established, presents many difficulties in classification. It seems to link the two genera *Kophobelemnon*, Asbjørnsen and *Sclerobelemnon*, Kölliker; and the alternatives are either to erect a new genus, which seems undesirable, or to unite the two under the older title *Kophobelemnon*. The following table gives the chief characteristics of these two genera and also those of our type:—

Kophobelemnon.	Sclerobelemnon.	"Investigator" Specimen.
Spicules in polyp and tentacles. ¹	Spicules only in lower part of polyp, not in tentacles.	No spicules in polyp or tentacles.
Four to six longitudinal rows of polyps.	Polyps arranged in two lateral strands of short oblique rows.	Polyps almost in a single row on each side.
Spicules: smooth angled needles, ¹ short plates and rods.	Spicules: biscuit-shaped, also flat, cornered spiny plates.	Spicules: angled plates—some with regular, others with ragged ends; spindles, some bifurcated.
Spicules only in cutis of stalk and keel, not in the interior.	Spicules sparse in cutis of stalk, abundant in the club round the zooids and polyps, not in the interior.	Spicules abundant in the rachis and also in the cutis of the stalk, but not in the interior.
Axis roundish quadrangular. ¹	Axis cylindrical, irregularly round with hint of roundish quadrangular.	Axis quadrangular.
Zooids—numerous with a spicule-sheath.	Zooids—numerous with a spicule-sheath.	Zooids—numerous with a spicule-sheath.

From the above it is evident that our specimen, although possessing certain of the essential characters of the two genera described, differs somewhat from both and could not be included in either. We do not feel inclined, however, to establish a new genus, inasmuch as the distinguishing features do not appear to us to be generic. We would rather suggest the abolition of *Sclerobelemnon*, retaining the species of both genera under the older genus *Kophobelemnon*, with *K. burgeri*, Herklots, and *K. intermedium*, n. sp., as connecting forms.

EMENDED DIAGNOSIS OF KOPHOBELEMNON.

Colony club-shaped or cylindrical with a narrow longitudinal zone on the ventral side free from autozooids; autozooids arranged in one or more longitudinal rows on each side; spicules in the body polyp and tentacles, in the lower half of the polyp only or in neither; siphonozooids numerous, in the spaces between the autozooids and surrounded by spicules; axis quadrangular or sub-cylindrical; spicules: angled needles, smooth rods, short plates, spindles and biscuit-shaped bodies in the cutis and rachis but absent from the interior.

Family VIRGULARIDÆ.

Sub-family Virgularinæ.

Virgularia elegans, Gray.

„ *juncea*, Pallas.

„ *ornata*, n. sp.

„ *fusca*, n. sp.

„ sp. ?

Scytalium martensii, Kolliker.

„ „ „ var. *magniflora*, n.

¹ *Kophobelemnon burgeri*, Herklots, approaches *Sclerobelemnon* in many respects, e.g., in (1) shape of spicules, (2) the small number of spicules in the polyps, and (3) the shape and nature of the axis.

GENUS VIRGULARIA, Lamarek.

This genus is represented in the collection by four species, two of which are new. There are also two young forms, too immature for exact specific determination. The following table adapted from K  lliker shows the systematic position of the "Investigator" specimens :—

I. Polyps borne by distinct pinnules :—

(A) Polyps at most 15 in number.

(B) Polyps over 15 in number.

18-25 polyps *V. elegans*, Gray.

40-45 „ *V. ornata*, n. sp.

60-65 „ *V. fusca*, n. sp.

II. Polyps borne by indistinct pinnules or ridges :—

10-20 polyps *V. juncea*, Pallas.

Virgularia elegans, Gray.

Belonging to this species there is a single elongated colony, with the basal portion broken off. It is 170 mm. in length and bears rudimentary pinnules to the very base. At the top of the rachis the pinnules are separated by intervals of 2 mm., but at the base they are closely contiguous. There are about 25 polyps in a single row on each pinnule. The rachis at the widest part is 4 mm. in breadth. The polyps are distinct in the upper part but are only marked off by constrictions in the pinnule in the lower portion. Apart from its larger size the specimen agrees closely with that described in the "Appendix to Aleyonaria, Ceylon Pearl Oyster Report" (Thomson, 1905).

The colour is creamy-white.

Locality : Orissa Coast, Marine Survey, 10 fathoms.

Previously recorded from Ceylon Seas.

Virgularia juncea, Pallas.

A single very slender specimen 435 mm. in length. For the first 145 mm. from the top the pinnules are distinct and separated by about 1.5 mm. For the next 155 mm. they are closely apposed and diminish gradually in length, so that for the last 45 mm. of the rachis they appear as minute dots. They overlap on the meta-rachidial surface, but leave a bare space on the pro-rachidial which is marked by a longitudinal groove. There is an elongated expansion at the base, but the rudimentary pinnules encroach on this region. The axis is cylindrical and disappears in the lower portion of the bladder. The specimen agrees closely with K  lliker's description and figure. The colour is creamy-white but the pinnules in the upper region are bluish.

Locality : Andamans.

Previously recorded from Borneo, Philippines, Indian Ocean, etc.

Virgularia ornata, n. sp.

To this species we refer a portion of a colony consisting of part of a rachis, 23 mm. in length, with 13 pinnules on each side.

The axis is very distinctive and is quadrilateral in section ; the meta-rachidial surface is broader than the pro-rachidial, but both are concave ; on the para-rachidial surfaces a distinct ridge extends throughout the entire length so as to form two longitudinal furrows on each side ; the surface is very rough and the whole is prismatic in structure.

The pinnules are S-shaped and overlap on the meta-rachidial aspect, but leave a bare space on the pro-rachidial surface, along the middle of which runs a shallow longitudinal furrow. The number of polyps on a pinnule varies greatly ; on the lowest present there are only twelve, but on the sixth pinnule farther up there are forty-five. These are apparently arranged in four rows, but this is due no doubt to secondary growth and crowding. The pinnules are separated by about 2 mm. No trace of nutritive canals was seen on the pro-rachidial surface.

The zooids are in three to four rows and are very distinct, forming a plate extending almost the whole distance between the pinnules and about equally separated from each.

This species approaches *V. rumphii*, Kölliker, but is distinguished from it by (1) the zooids in three to four rows ; (2) the shape of the axis ; (3) the apparent absence of nutritive canals on the pro-rachidial surface. This last character is of doubtful specific importance, but the two others mark our specimen as distinct from *V. rumphii*.

Locality : Andamans.

Virgularia fusca, n. sp.

A fine specimen of this distinct species of a brownish-black colour.

Length of colony 140 mm.

Breadth of rachis 6.5 mm.

Number of well-developed pinnules 40/38.

Number of polyps on a pinnule . 60-65.

Diameter of bladder 5 mm.

About 18 mm. from the base the pinnules start as insignificant dots and continue so for about 20 mm. Beyond this they gradually increase in size, but for the next 28 mm. the polyps are not distinct. The well-developed pinnules are S-shaped and very much contorted ; the pro-rachidial insertion is slightly higher than the meta-rachidial. They have a broad insertion and bear 60-65

barrel-shaped polyps apparently arranged in three to four rows. This appearance is due no doubt to the twisting of the pinnule and the greater development of the polyps. The well-developed pinnules are 2.5 mm. in height and separated by about 2 mm. They overlap on the meta-rachidial surface, but leave a bare space, marked by a deep longitudinal furrow, on the pro-rachidial aspect. No definite zooids nor hint of nutritive canals was visible.

The coenenchyma is thin, but the outer covering is tough and has a tessellated appearance. At the base of the rachis there is small elongated swelling with a very thick wall, but part of this region is also marked by diminutive pinnules.

The axis is cylindrical and smooth, with a brownish exterior and a white calcareous cone. No trace of limy bodies was found in the stalk or bladder.

This species approaches *V. rumphii*, but is distinguished from it by the large number of polyps, the absence of spicules, and several other features.

Locality : Andamans. Marine Survey.

Virgularia, sp. ?

Two young colonies which we have hesitation in placing in any species. They are immature and show the gradual development of the pinnules. In details they are different and neither agrees with any described species.

(A) The larger is 45 mm. in length and bears twenty-three pinnules seen as distinct with the naked eye. The pinnules are separated by about 1.75 mm. They are placed obliquely, the pro-rachidial insertion being considerably higher than the meta-rachidial, and about the level of the meta-rachidial insertion of the next higher pinnule. There are from four to six polyps on each pinnule, quite distinct from one another. The pinnules meet and overlap on the meta-rachidial surface. All stages of rudimentary pinnules down to minute points are present. The axis is cylindrical and tapers to a point at each end.

(B) The other is 35 mm. in length, and bears twelve distinct pinnules on each side. All stages of rudimentary pinnules are present. The meta-rachidial and pro-rachidial insertions are about the same level. The pinnules are small and overlap on the meta-rachidial surface. The polyps, which are six to eight in number, are distinct and leave only a narrow strip at the base of the pinnule. The axis is cylindrical and tapers to both ends. There is a small swelling at the end of the stalk.

Locality : Andamans, Marine Survey, 15 fathoms.

GENUS SCYTALIUM, Herklots.

Scytalium martensii, K  lliker. Plate V. figs. 1 and 5.

Several portions of what is apparently one colony about 600 mm. in length, also portions of another smaller colony, agree closely with K  lliker's

description of this species. The stalk of the larger colony is 105 mm. in length and has a slight swelling about the middle.

Both the pro- and meta-rachidial surfaces are free throughout their entire length and are densely covered with small, longitudinally arranged spicules which give them a red colour. The pinnules are rudimentary and are borne on the para-rachidial surfaces. There are six to thirteen polyps on each pinnule, the number varying according to the position on the rachis. The polyps themselves are white, but are supported by groups of red spicules which mark their position definitely almost to the base of the pinnule. The pinnules are separated by distances of about 2 mm. The position of the zooids is half-lateral, half-ventral, and each is surrounded by a number of small projecting spicules.

Locality: Off Ceylon, 34 fathoms.

Previously recorded from the Chinese Sea.

Scytalium martensii, K  lliker, var. *magniflora*, nov.

We have referred to a new variety of this species a specimen which differs from K  lliker's type mainly in the size of the pinnules. The following are some of the measurements in millimetres:—

Total length of colony	285
Length of rachis	225
Length of stalk	60
Diameter of stalk	2
Length of pinnule	5
Breadth of pinnule	3.5
Distance between pinnules :	4.7.5
Diameter of axis	1

The pinnules are much larger than in the type specimen and bear more polyps. Near the base of the rachis there are about eighteen polyps on one pinnule, five of which are rudimentary, but towards the tip there are twenty-one, four of which are rudimentary. There are about sixty pinnules on each of the para-rachidial surfaces, but towards the base the polyps are separated for almost their entire length, eventually appearing as groups of isolated polyps. The colour pattern is identical with that in *S. martensii*, but in some places, especially on the stalk and lower surface of the pinnules, there is a greater abundance of red spicules.

The axis is quadrangular in section, the pro- and meta-rachidial surfaces being slightly broader. There is a slight groove on all the sides. In the stalk the axis approaches a cylindrical form.

The polyps are white and are surrounded by groups of short red spicules which pass up the aboral surface of the tentacles in triangular bands.

The following table gives the main points of distinction between *S. sarsii*, *S. martensii*, K  lliker, and *S. martensii*, var. *magniflora*, nov.

<i>S. sarsii</i> .	<i>S. martensii</i> .	<i>S. martensii</i> , var. <i>magniflora</i> .
Pinnules overlap. Polyps eighteen to twenty in two rows. Zooids in two rows, lateral, extending on to the ventral surface of the keel.	Pinnules free. Polyps nine to thirteen in a single row. Zooids half-ventral, half-lateral, surrounded by red spicules.	Pinnules free. Polyps eighteen to twenty-one in a single row. Zooids on lateral-ventral margin in an irregular double row, diminishing to a single row at either end.
Polyps with red needles on the upper surface.	Polyps surrounded by red needles. Stalk colourless.	Polyps surrounded by red needles except near tip of rachis. Stalk very red.

The new variety is distinguished by (1) the larger size of the pinnules ; (2) the greater number of polyps ; (3) the disposition of the zooids ; and (4) the greater abundance of spicules in the cutis of the stalk.

Locality : Andamans, 60 fathoms.

Family *PENNATULIDÆ*.

Sub-family Pennatulina  .

Pennatula indica, Thomson and Henderson.

Sub-family Pteroeidid  .

Pteroeides nigrum, K  lliker.

„ *lacazii*, var. *spinosum*, K  lliker.

„ *ilicifolium*, n. sp.

„ *multiradiatum*, K  lliker.

„ *intermedium*, n. sp.

„ *griseum*, K  lliker.

„ *robustum*, n. sp.

„ *mac-andrewi*, K  lliker.

„ *andamanense*, n. sp.

„ *indicum*, n. sp.

„ *punctatum*, n. sp.

„ *flavidum*, K  lliker.

„ *crassum*, K  lliker.

„ *hymenocaulon*, Bleeker.

„ *steenstrupi*, K  lliker.

„ *esperii*, Herklots.

„ „ „ var. *armatum*, n.

GENUS PENNATULA, L.

Pennatula indica, Thomson and Henderson.

Two small colonies of this species as described in the " 'Investigator' Deep-Sea Forms". The following are the measurements in millimetres :—

Total length of colony	. . . . .	84, 40
Length of rachis	. . . . .	45, 26
Breadth of keel	. . . . .	2
Thickness of stalk	. . . . .	1.75
Number of pinnules	. . . . .	26/25
Length of largest pinnule	. . . . .	8
Breadth of insertion of largest pinnule	. . . . .	2
Number of polyps on largest pinnule	. . . . .	7

The general colour is more yellowish, but this is due to a less degree of development of spicules. On the upper surface of the pinnules there are only bands of spicules, whereas on the type specimens the whole surface was covered. Many of the polyps are not contracted and the longitudinal arrangement of spicules on the tentacles is well seen.

As an addition to the diagnosis we would note the presence of a single sinuating row of zooids on the dorsal aspect of the keel touching the insertion of the pinnules.

The smaller specimen is too young to allow of accurate measurements and estimation of numbers.

Locality ; Station 343, 23° 46' 15" N. and 58° 31' 50" E., 609 fathoms.

GENUS PTEROEIDES, Herklots.

General Note on the Genus Pteroeides.

This genus affords a good illustration of considerable variety within a narrow range. In regard to the constancy of the number of rays—a feature to which Kölliker gave much prominence—we counted the rays on all the pinnules of ten specimens of *P. punctatum*, n. sp., and found a certain number (10) almost constant, only varying by one on either side. But a similar enumeration for *P. crassum*, Kölliker, revealed great variability (see Table), namely, 11-28. As in many other cases it is necessary to take an assemblage of characters into account in determining the position of a specimen of *Pteroeides*.

Table of Species of Pteroeides included in this collection, arranged according to Kölliker's classification.

I. Zooid-plate basal.

- (A) Zooid-streak of the keel long and narrow.
- | | |
|--|--|
| (1) Rachis more than six times longer than broad | argenteum group. |
| without definite rays | <i>P. nigrum</i> , Kölliker. |
| (2) Rachis at most twice as long as broad | lacazii group. |
| 11-16 rays | <i>P. lacazii</i> var. <i>spinosum</i> , Kölliker. |
| colony very rigid and much contorted, 14 rays | <i>P. ilicifolium</i> , n. sp. |
| 21-27 rays | <i>P. multiradiatum</i> , Kölliker. |
| 8-10 rays | <i>P. intermedium</i> , n. sp. |
- (B) Zooid-streak of the keel short and broad
- | | |
|--------------------------|-------------------------------|
| 11-22 rays, mostly 14-16 | griseum group. |
| 15-19 rays | <i>P. griseum</i> , Kölliker. |
| | <i>P. robustum</i> , n. sp. |

II. Zooid-plate median.

- (A) Pinnules ventrally passing on to the keel with a cushion
- caledonicum group.
- (B) Pinnules without a ventral cushion
- pellucidum group.
- | | |
|---------------------------------------|-----------------------------------|
| rays all seem to arise from one point | <i>P. mac-andrewi</i> , Kölliker. |
| 8-10 rays | <i>P. andamanense</i> , n. sp. |
| pinnules transparent, 17 rays | <i>P. indicum</i> , n. sp. |
| 9-11 rays | <i>P. punctatum</i> , n. sp. |

III. Zooid-plate marginal.

- (A) Short main rays which only extend to the polyp zone
- breviradiatum group.
- (B) Long main rays.
- (AA) Pinnules thick.
- (1) Pinnules with superior zooids; distinct rays; regular spines; ventral zooid-streak
- tenerum group.
- zooid-plate large, 18-23 rays
- P. flavidum*, Kölliker.
- (2) Rays indistinct; spines irregular; no ventral zooid-streak; rarely superior zooids
- sarcocaulon group.
- 28-33 rays
- P. crassum*, Kölliker.
- (BB) Pinnules thin.
- (1) Keel spongy
- hymenocaulon group.
- 11 rays
- P. hymenocaulon*, Bleeker.
- 20-24 rays
- P. steenstrupi*, Kölliker.
- (2) Keel firmer in the interior
- esper group.
- ventral zooid-streak, 11-14 rays
- P. esperi*, Herklots.
- 14 rays
- P. esperi*, var. *armatum*, nov.

Pteroeides nigrum, Kölliker.

A single colony from which the tip of the rachis has been broken, leaving the nude axis projecting.

Total length of colony	95 + ¹ mm.
Length of rachis	40 + mm.
Breadth of rachis	20 mm.
Length of stalk	55 mm.
Thickness of stalk	6 mm.
Number of pinnules	15 +
Number of rays	none distinct.
Length of pro-rachidial margin of largest pinnule	13 mm.
Breadth of insertion of largest pinnule	4 mm.
Breadth of largest pinnule (<i>i.e.</i> , from the pro-rachidial insertion to the middle of the meta-rachidial margin)	11 mm.
Distance between pinnules	1.5 mm.

This specimen agrees with K  lliker's description of *P. nigrum*, but although the outer covering of the stalk and keel contains abundant limy needles, none were found corresponding to his maximum measurement, *viz.*, 1.5 mm. The pinnules are fan-shaped and are supported by numerous longitudinally disposed, interlacing calcareous rods. There is no indication of grouping into distinct rays. The zooid-plate is large and basal and there is also a long narrow zooid-streak on the upper part of the meta-rachidial surface. The polyps occur on the upper surface of the pinnules in three or four rows, and each is supported by a sheaf of small longitudinally disposed needles. The colour in spirit is whitish, but there is evidence of loss of colour, bluish-black streaks occurring here and there on the pinnules and on the keel.

Locality : Ganjam Coast, 14-9 fathoms.

The locality of K  lliker's specimen is unknown.

***Pteroeides lacazii*, var. *spinosum*, K  lliker.**

To this very variable species we refer three specimens in the collection. In all respects they fall within the degree of variation indicated by K  lliker for the variety *spinosum*.

	A	B	C
Total length of colony	155 mm.	150 mm.	135 mm.
Length of rachis	95 „	70 „	75 „
Breadth of rachis	50 „	43 „	35 „
Length of stalk	65 „	80 „	60 „
Thickness of stalk	18 „	60 „	10 „
Number of pinnules	30	37	44
Number of rays	16-17	11-16	11-16

¹ + denotes that the exact length is not definitely known.

	A	B	C
Length of pro-rachidial margin of largest pinnule	16 mm.	16 mm.	12 mm.
Breadth of insertion of largest pinnule	6 „	8 „	8 „
Breadth of largest pinnule	14 „	16 „	11 „
Distance between pinnules	2.5 „	1.5 „	1.5 „

The zooid-plate is basal. It is large, thick and very distinct, the yellow colour contrasting with the mottled appearance of the pinnule. The zooid-streak on the meta-rachidial surface is long and narrow, consisting of a single row, but at one point on specimen A there are three abreast. The pinnules are fan-shaped, very broad and thick. The rays, which are eleven to seventeen in number, are composite and substantial, but in one specimen (A) this is not so marked; consequently the margin is much more ragged and numerous limy needles occur in the polyp region. In C the meta-rachidial surface is free throughout its entire length, but in A and B the pinnules overlap towards the upper end. The lower part of the stalk is hollow, considerably expanded in A, very slightly in C, and markedly conical in B. The polyps occur mainly on the lower side of the pinnules and there are a few scattered zooids on the upper surface.

The fundamental colour is yellow, but the pinnules and parts of the rachis, especially the pro-rachidial surface, are mottled with green, blue and purple patches, which appear iridescent.

Localities : A—King Island, Mergui.

B and C—Andamans.

Previously recorded from Raffles Bay (Australia); Palaos (Carolines); var. *molle* from Penang, Sumatra, Australia.

***Pteroeides ilicifolium*, n. sp.**

A small dark brown colony; the lower part of the stalk broken.

Total length of colony	35 mm.
Length of rachis	25 mm.
Breadth of rachis	25 mm.
Length of stalk	10 + ¹ mm.
Thickness of stalk	3 mm.
Number of pinnules	12
Number of rays	14
Length of pro-rachidial margin of largest pinnule	11.5 mm.
Breadth of insertion of largest pinnule	7 mm.
Breadth of largest pinnule	12 mm.
Distance between pinnules	1.5 mm.

¹ + denotes that the exact length is not definitely known.

The specimen for which we suggest this new species is obviously distinct from the others in the collection and is unique in many respects. The zooid-plate is basal and clearly defined, extending in a crescent about half-way up the pinnule, but, being of the same colour as the latter, it is hardly visible to the naked eye. The length and breadth of the rachis are equal, so that it falls into Kölliker's *lucazii*-group. The number of rays is fourteen, hence it comes nearest to *P. lucazii*, Kölliker. We are unable, however, to identify it with any of the varieties of this species.

The whole colony is very hard in texture and is quite inflexible. The pinnules are fan-shaped and very much contorted, so that the general appearance is that of a very spiny "holly-leaf," hence the name.

No zooid-streak could be discerned on the meta-rachidial surface, but there is a deep groove on the pro-rachidial surface of the keel. The rays are fairly distinct, being visible to the naked eye. They are composed of two to four adjacent spines, all of which (or in some cases only one) may project beyond the margin for a distance of 1 to 2.5 mm.

The pro-rachidial insertion of the pinnules is slightly higher than the meta-rachidial and there are no rudimentary pinnules at the base. The majority of the polyps are situated along the margin, but some occur on both surfaces extending about one-quarter down the pinnule. There are no limy needles in the polyp region, but a few very minute forms occur in the keel. Between the pro-rachidial insertion of the pinnule and the keel there are about four or five small projecting spines. The whole of the meta-rachidial surface of the keel is covered by the overlapping pinnules.

The colour of the colony is warm-brown, but a few darker patches occur on the pro-rachidial surface.

Locality : Off Cape Comorin, 9 fathoms.

***Pteroeides multiradiatum*, Kölliker.**

A single specimen ; only the rachis represented.

Total length of colony	. . . . .	95 + mm.
Length of rachis	. . . . .	85 mm.
Breadth of rachis	. . . . .	52 mm.
Length of stalk (only axis left)	. . . . .	10 + mm.
Thickness of stalk	. . . . .	unknown.
Number of pinnules	. . . . .	29
Number of rays	. . . . .	22-25
Length of pro-rachidial margin of largest pinnule	. . . . .	22 mm.
Breadth of insertion of largest pinnule	. . . . .	6 mm.
Breadth of largest pinnule	. . . . .	21 mm.
Distance between pinnules	. . . . .	2 mm.

The zooid-plate is large and basal, extending almost to the polyp region. The meta-rachidial zooid-streak is long and narrow, consisting of a single row of widely separated zooids towards the upper extremity. The rays, which are about twenty-five in number, are not very prominent and in only a few cases project beyond the margin. They are only faintly visible to the naked eye. The polyps are numerous, the greater number being congregated along the margin, but a few occur on both surfaces, though mostly on the upper side. The keel is very broad and is bare on both the pro-rachidial and the meta-rachidial aspects. The colour of the colony is orange-yellow.

Locality: Unknown; No. $\frac{3444}{3}$ Marine Survey.

Previously recorded from Pulo Penang (Expedition of the "Galathea").

***Pteroeides intermedium*, n. sp. Plate VI. fig. 9.**

A single colony very much expanded in one plane represents this species.

Total length of colony	75 mm.
Length of rachis	45 mm.
Breadth of rachis	40 mm.
Length of stalk	35 mm.
Thickness of stalk	7 mm.
Number of pinnules	18
Number of rays	8-10
Length of pro-rachidial margin of largest pinnule .	19 mm.
Breadth of insertion of largest pinnule	4.5 mm.
Breadth of largest pinnule	16 mm.
Distance between pinnules	2 mm.

This specimen has a basal zooid-plate and the rachis is slightly longer than broad, so that it is included in Kölliker's *lacazii*-group. The number of rays is about eight to ten, and thus it is intermediate between *P. hartingii*, Kölliker, and *P. lacazii*, Kölliker, the former having four to six and the latter eleven to sixteen rays.

The keel and stalk are moderately soft, and both the meta-rachidial and pro-rachidial surfaces are free throughout their entire length. The pinnules are almost scalpel-shaped and have a very narrow insertion. All are distinctly lateral, but the rudimentary forms at the base turn towards the pro-rachidial surface. The pinnules are thin and flexible and bear a few small limy needles in the polyp-zone. There are also minute spicules in the keel and stalk. The rays consist of six or eight spines and are very strong. They project markedly, sometimes extending 4 mm. beyond the margin. On the lower surface they are very prominent, but on the upper surface can be discerned only with difficulty

except near the base. They form one of the most characteristic features of the species.

The zooid-plate is small and inconspicuous, extending hardly one-quarter up the pinnule. It is crescentic in shape and is clearly defined, both the pro-rachidial and the meta-rachidial origins being almost as long as median radius. The polyps are brown in colour and are clustered mostly on the margin, but a few extend about one-third down the upper surface, on the lower only about one-fourth, thus leaving a distinct space between the polyp-zone and the zooid-plate equal to about one-half of the pinnule.

The colour is light brown, but there are purple streaks occupying many of the interrachial spaces, and there is a large bluish patch on the pro-rachidial surface of the keel.

Locality : Andamans.

Pteroeides griseum, Kölliker.

A single colony of a very remarkable appearance represents this very variable species.

Total length of colony	105 mm.
Length of rachis	50 mm.
Breadth of rachis	45 mm.
Length of stalk	60 mm.
Thickness of stalk	10 mm.
Number of pinnules	26
Number of rays	19-20
Length of pro-rachidial margin of largest pinnule	17 mm.
Breadth of insertion of largest pinnule	8 mm.
Breadth of largest pinnule	19 mm.
Distance between pinnules	1.5 mm.

The stalk is soft and swollen immediately below the rachis, and from this it tapers to the tip in a steep cone. The upper half of the meta-rachidial surface of the keel is covered by the overlapping pinnules, which are fan-shaped and very broad. The rays are quite soft and flexible, a condition due probably to a pathological variation, seen also in one of the specimens of *P. robustum*, n. sp. In the polyp region on the upper surface of the pinnules there are also numerous needle-shaped bodies of a similar consistency. In other respects this form agrees with Kölliker's *P. griseum*.

Locality : Unknown ; No. $\frac{3443}{3}$ (Dr. J. Anderson).

Previously recorded from Adriatic Sea, Mediterranean Sea.

Pteroeides robustum, n. sp.

Two large colonies represent this new species.

Specimen	A	B
Total length of colony	115 mm.	115 mm.
Length of rachis	65 mm.	65 mm.
Breadth of rachis	60 mm.	60 mm.
Length of stalk	50 mm.	50 mm.
Thickness of stalk	20 mm.	18 mm.
Number of pinnules	24 mm.	27 mm.
Number of rays	18-19	15-17
Length of pro-rachidial margin of largest pinnule	22 mm.	25 mm.
Breadth of insertion of largest pinnule	9 mm.	10 mm.
Breadth of largest pinnule	20 mm.	21 mm.
Distance between pinnules	1.5 mm.	2 mm.

This new species is included in Kölliker's *griseum*-group. The zooid-plate is basal, with a hint of a free space about the middle.

Both the colonies are large, thick and very substantial. The stalk is spongy and considerably swollen; the pro-rachidial surface of the keel is very broad and elliptical in shape. The pinnules overlap from either side and cover the meta-rachidial surface, except near the base where a heart-shaped bare space is left.

The pinnules are large, thick and fan-shaped, some almost approaching the form of a quadrant. There is a slight swelling or cushion at the pro-rachidial insertion. The zooid-plate is large and conspicuous, reaching almost to the polyp-zone on the meta-rachidial side. The rays vary in number in the two specimens, in A, 18-19, in B, 15-17. They are composed of six to eight spines and are very prominent, projecting slightly beyond the margin in a serrated edge. The lower rudimentary pinnules are spatula-shaped and are inserted towards the pro-rachidial surface, but the main pinnules are distinctly lateral.

The polyps are situated on both surfaces in five or six rows which extend almost half-way down the pinnules. There are also a few scattered zooids on the upper surface of the pinnules. There are no limy needles either in the polyp region or in the keel and stalk.

The colour in spirit is creamy-white, but on the stalk and keel there are bluish and brown spots.

The same pathological condition of the rays as that referred to in *P. griseum* is here present in specimen B. This species differs from *P. griseum* in the fact that the polyps are not marginal; it resembles *P. schlegelii* in the ventral shunting of the rudimentary basal pinnules.

Localities : A—Akyab.

B—Andamans.

Pteroeides mac-andrewi, K  lliker.

Three young specimens represent this species.

	A	B	C
Total length of colony	50 mm.	65 mm.	45 mm.
Length of rachis	25 ,,	35 ,,	25 ,,
Breadth of rachis	8 ,,	30 ,,	15 ,,
Length of stalk	25 ,,	35 ,,	30 ,,
Thickness of stalk	3.5 ,,	7 ,,	2 ,,
Number of pinnules	15	16	16
Number of rays	5 ¹	5 ¹	1
Length of pro-rachidial margin of largest pinnule	10 mm.	13 mm.	12 mm.
Breadth of insertion of largest pinnule	3 ,,	4 ,,	2 ,,
Breadth of largest pinnule	7 ,,	8 ,,	7 ,,
Distance between pinnules	1 ,,	2 ,,	1.25 ,,

These specimens are specially interesting in illustration of the gradual development of a peculiar type of pinnule—with the rays seeming to arise from one main ray, which is also seen in *P. rhomboidale*, Moroff.

The zooid-plate appears basal, but on closer inspection we find that it arises at the pro-rachidial insertion of the pinnule where it is about 3 mm. high; from this point it passes upwards and departs from the line of insertion and gradually tapers towards the meta-rachidial insertion, where it is reduced almost to a single zooid. It is thus median and the species is included in K  lliker's pellucidum group.

The mode of development of the pinnules is exemplified through different stages in the more mature specimen A, but is better seen in B and C where a less advanced stage has been reached. In C there is but one main ray along the pro-rachidial margin. From this towards the meta-rachidial side numerous smaller rays arise like the barbs from a rachis. The single main ray is very broad and substantial, being composed of about five rows of rods lying abreast and interlocking, no single rod extending the whole length. Between this stage and the highest developed in our specimens, *viz.*, that with five main rays, intermediate forms with two, three, and four occur in B and A. There seems to be a gradual differentiating into groups which become more robust than the others, but in all cases their origin can be traced to the original single ray. In the more advanced cases there are six to eight spines in each ray, but the same structure as in the younger forms is traceable throughout. A noteworthy fact is that between the first two rays on the pro-rachidial margin there are numerous

¹ There are in both cases five main rays, but in addition to these there are numerous smaller rays between the first two, counting from the pro-rachidial margin.

smaller spines, doubtless the incipient stage of the next new ray. The sharp points of the rays may project as much as 2 mm., and give the pinnules a spiny margin.

The pinnules present all grades from narrow scalpel-shaped forms to almost fan-shaped types.

The polyps are numerous and are confined to the margin of the pinnules. These meet and overlap on the meta-rachidial surface, except in the oldest specimen where there is a free space on the lower half.

The colour varies in the three types; the smallest (C) is light brown, the next (B) is considerably darker with bluish spots studded over it, while the largest (A) is very pale brown with purple patches, especially on the pro-rachidial surface. This difference in colour may be due to the preservation.

Locality; Andamans.

Previously recorded from Gulf of Suez.

***Pteroeides andamanense*, n. sp.** Plate VI. fig. 6.

A single specimen of a yellowish colour represents this new species.

Total length of colony	75 mm.
Length of rachis	45 mm.
Breadth of rachis	30 mm.
Length of stalk	30 mm.
Thickness of stalk	4·5 mm.
Number of pinnules	16
Number of rays	8-10
Length of pro-rachidial margin of largest pinnule .	11 mm.
Breadth of insertion of largest pinnule	3·5 mm.
Breadth of largest pinnule	8·5 mm.
Distance between pinnules	3 mm.

The whole colony is very much flattened in one plane.

The zooid-plate is median, and there is no cushion at the pro-rachidial insertion of the pinnule, so that the species falls into the pellucidum-group. The stalk and keel are tough, and the former tapers gently to a point where it is slightly incurved. The pinnules are thin and the pro-rachidial insertion is higher than the meta-rachidial. They are developed laterally and do not meet on the meta-rachidial surface except for a short space at the upper end. No pinnules are developed at the extreme tip of the rachis. Between the meta-rachidial insertion and the keel there are a number of small projecting spines, generally three to five. The rays are eight to ten in number and are composed of two to four spines which project in some cases 2 to 3 mm. They are large and conspicuous. There are no small needles in the zooid region.

No zooid-streak was visible. The polyps are very indistinct and occur on both sides, though mainly on the upper surface of the pinnules. The polyp region extends almost to the zooid-plate on the lower surface. Their position can be located in many cases only by means of the mesenteries appearing through the transparent walls.

This species is distinguished from—

- (a) *P. breve*, Kölliker, (1) by having only eight to ten rays instead of fifteen to sixteen; (2) by the narrow insertion of the pinnules; (3) by the fact that there *are* rudimentary pinnules at the lower end; and (4) inasmuch as the pinnules do not all stand straight out from the keel.
- (b) *P. pellucidum*, Kölliker, (1) by the more sickle-shaped pinnules; (2) by the general contour of the colony; (3) by the long free space on the meta-rachidial surface; and (4) in not having a broad polyp-zone and large polyps. It agrees with this species in the fact that both have short spines at the pro-rachidial insertion of the pinnule.
- (c) *P. mac-andrewi*, Kölliker, by the mode of origin of the rays in the pinnules.

Locality : Andamans.

Pteroeides indicum, n. sp.

A single large specimen of a light brown colour represents this species.

Total length of colony	115 mm.
Length of rachis	90 mm.
Breadth of rachis	70 mm.
Length of stalk	25 mm.
Thickness of stalk	9 mm.
Number of pinnules	27
Number of rays	17
Length of pro-rachidial margin of largest pinnule .	30 mm.
Breadth of insertion of largest pinnule	10 mm.
Breadth of largest pinnule	21 mm.
Distance between pinnules	12 mm.

The zooid-plate is median and as there is no ventral cushion it falls into Kölliker's pellucidum-group.

The stalk is hard; it is comparatively thin and has a swelling just below the base of the rachis. The keel is much broader than the stalk and has the shape of an elongated ellipse. The rind is tough and parchment-like but the interior is spongy. The pinnules are developed laterally, but towards the base there is a distinct shunting towards the pro-rachidial surface, the lowest pair being separated by about 4 mm. They are fan-shaped and more distant (12 mm.)

than in any other species we have examined. The meta-rachidial surface is quite hidden by the overlapping pinnules, except near the tip where they are turned towards the pro-rachidial surface. The lower rudimentary pinnules are spatula-like. All are exceedingly transparent so that the mesenteries with their chain-like series of minute ova may be traced to the very base of the pinnule. The rays are not very strongly developed, and project but little beyond the margin. They are best seen on the lower surface. The zooid-plate is median and very narrow, scarcely visible to the naked eye. The polyps occur for the most part along the margin, but two to three rows occur on both sides extending about one-quarter down the pinnule. There are numerous small needles in the polyp region; a few also occur in the keel, but no trace could be found in the stalk.

This form approaches *P. brachycaulon*, K  lliker, but may be distinguished from it in the following respects: (1) there is a much narrower zooid-plate; (2) the rays are more delicate; (3) the meta-rachidial surface is covered by the pinnules which are transparent. From *P. manillense*, K  lliker, it may be distinguished by (1) the presence of spicules in the polyp region; (2) the greater number of rays; (3) its transparent pinnules.

Locality: Off Colombo, 26½ fathoms. Marine Survey.

Pteroeides punctatum, n. sp. Plate II. figs. 1 and 4.

Ten small pale-coloured specimens. The following are the measurements of the most complete colonies:—

Total length of colony	. 70 mm.	55 mm.	50 mm.	50 mm.	53 mm.	45 mm.
Length of rachis	. 45 "	40 "	35 "	30 "	30 "	23 "
Breadth of rachis	. 40 "	35 "	25 "	25 "	16 "	20 "
Length of stalk	. 25 "	15 "	15 "	20 "	23 "	22 "
Thickness of stalk	. 15 "	8 "	5 "	9 "	6 "	6 "
Number of pinnules	. 25	21	17	22	21	20
Number of rays	. 10	10	11	10	10	9
Length of pro-rachidial margin of largest pinnule	18 mm.	15 mm.	11 mm.	9 mm.	8 mm.	7 mm.
Breadth of insertion of largest pinnule	. 5 "	5 "	3 "	3 "	2.5 "	2 "
Breadth of largest pinnule	11 "	11 "	9 "	7.5 "	6 "	5 "
Distance between pinnules	2 "	2 "	2 "	2 "	1.75 "	1.25 "

The zooid-plate is median and broad and there is no cushion at the pro-rachidial insertion of the pinnules. The number of rays is about ten to eleven, so that it approaches *P. pellucidum*, K  lliker, and *P. manillense*, K  lliker, the former having ten to eleven rays and the latter eleven to thirteen.

The stalk is thick and conical and enroaches on the rachis in the form of an inverted V. It is soft and spongy and contains no limy needles. Both the

pro-rachidial and the meta-rachidial surfaces of the keel are free throughout their entire length.

The pinnules are narrow and sickle-shaped. The zooid-plate is broad on the pro-rachidial surface ; from this it arches towards the meta-rachidial insertion, tapering almost to a point, but it can hardly be called *small* as in *P. manillense*, K  lliker. It is visible to the naked eye.

The rays of the pinnules are very conspicuous and are composed of about five spines abreast in some places. The polyps occur in four to five rows on both sides of the pinnules, extending on the lower side almost to the zooid-plate. They project markedly beyond the margin which has a serrated appearance. There are a number of superior zooids on the pinnules and abundant limy needles in the polyp region.

The following table contrasts this species with *P. pellucidum* and *P. manillense* :—

<i>P. punctatum</i> , n. sp.	<i>P. manillense</i> , K��lliker.	<i>P. pellucidum</i> , K��lliker.
(1) Zooid-plate broad on pro-rachidial margin and tapers to a point on the meta-rachidial surface.	Zooid-plate broad on pro-rachidial margin and tapers to a point on the meta-rachidial surface.	Zooid-plate almost uniform throughout.
(2) Zooid-plate not small.	Zooid-plate small.	Zooid-plate large.
(3) Pinnules sickle-shaped.	Pinnules fan-shaped.	Pinnules fan-shaped.
(4) Needles in polyp-zone.	Needles in polyp-zone.	No needles in polyp-zone.
(5) Superior zooids.	No superior zooids.	No superior zooids.
(6) No projecting spines.	Projecting spines at pro-rachidial insertion of pinnules.	No projecting spines.
(7) Rays visible in region of zooid-plate.	Rays not visible in region of zooid-plate.	Rays visible in region of zooid-plate.

The colour is creamy-white, but the stalk and rachis are studded with bluish spots which are also seen in the pinnules.

Locality : Near Palk Strait, 7 fathoms. Marine Survey.

Pteroeides flavidum, K  lliker.

A single specimen of a cream-white colour with the following measurements :—

Total length of colony	. . . . .	95 mm.
Length of rachis	. . . . .	50 mm.
Breadth of rachis	. . . . .	50 mm.
Length of stalk	. . . . .	45 mm.
Thickness of stalk	. . . . .	17 mm.
Number of pinnules	. . . . .	26
Number of rays	. . . . .	18-22

Length of pro-rachidial margin of largest pinnule .	24 mm.
Breadth of insertion of largest pinnule	10 mm.
Breadth of largest pinnule	16 mm.
Distance between pinnules	2.5 mm.

The stalk is slightly conical with a swelling at the base of the rachis. Both the meta-rachidial and the pro-rachidial surfaces of the keel are free throughout their entire length. On the meta-rachidial surface the pinnules almost meet at the upper end but leave a heart-shaped space at the base. The pinnules are disposed laterally, but at the lower end they suddenly approximate towards the pro-rachidial surface, so as to enclose a boat-shaped area with a long elliptical keel. They are fan- to sickle-shaped, fairly thick and opaque. The zooid-plate is marginal and extends well into the polyp region. No trace of a zooid-streak could be found. The polyps are disposed in five to six rows on both surfaces of the pinnules. Numerous large ova are seen attached to the mesenteries which extend almost to the base of the pinnules. There are a number of long limy needles in the polyp region. The rays are not very strong; they project in some cases 2 mm., but this is by no means regular.

Locality; Unknown; No. $\frac{3442}{3}$ (Dr. J. Anderson).

Previously recorded from Java.

Pteroeides crassum, Kölliker.

Specimen.	I.	II.	III.	IV.	V.	VI.
Total length of colony . . .	100 mm.	100 mm.	100 mm.	90 mm.	90 mm.	30 mm.
Length of rachis	50 "	50 "	50 "	60 "	45 "	20 "
Breadth of rachis	60 "	50 "	55 "	45 "	35 "	25 "
Length of stalk	40 "	50 "	45 "	45 "	55 "	5 "
Thickness of stalk	17 "	16 "	11 "	10 "	13 "	4.5 "
Number of pinnules	34	33	25	23	27	16
Number of rays	28	26	20	18	16	11
Length of pro-rachidial margin of largest pinnule . .	28 mm.	21 mm.	21 mm.	18 mm.	14 mm.	11 mm.
Breadth of insertion of largest pinnule	18 "	12 "	8 "	10 "	7 "	4 "
Breadth of largest pinnule	24 "	15 "	12 "	12 "	11 "	9 "
Distance between pinnules	2 "	2 "	2 "	1.5 "	1.5 "	1 "

Six specimens represent this species. The colour of the stalk and keel is yellow, with green, blue and purple streaks; that of the pinnules is pale yellow while the polyps are brown with blue markings, the latter giving the characteristic appearance to the colony. The rachis, when viewed from the meta-rachidial surface, is heart-shaped, but from the pro-rachidial surface it appears oval. The pinnules are broad and fan-shaped, but the lower rudimentary forms are scalpel-shaped and approach the pro-rachidial surface. The number of rays

varies considerably, in one specimen the maximum was eleven while in another it was twenty-eight. They are very strong and conspicuous. They consist of three to four spines and project beyond the margin giving the latter a serrated appearance. The zooid-plate is large and marginal. The polyps occur on both sides of the pinnules, seven to eight rows on the upper and five to six rows on the lower surface. There are no limy needles either in the zooid region or in the stalk and keel. No zooid-streak was found.

Locality : Andamans.

Previously recorded from Singapore.

Pteroeides hymenocaulon, Bleeker.

A small very flaccid colony of a brown colour.

Total length of colony	60 mm.
Length of rachis	40 mm.
Breadth of rachis	30 mm.
Length of stalk	20 mm.
Thickness of stalk	7 mm.
Number of pinnules	21
Number of rays	11
Length of pro-rachidial margin of largest pinnule	12 mm.
Breadth of insertion of largest pinnule	4 mm.
Breadth of largest pinnule	10 mm.
Distance between pinnules	3 mm.

The stalk is soft and spongy and contains numerous small needles. Both the pro-rachidial and meta-rachidial surfaces are free throughout their entire length. The pinnules are thin and lancet-shaped, and are supported by long rays, consisting of two to three spines, which project in many cases 2 mm. The zooid-plate is large and marginal but is not visible to the naked eye. The polyps occur on both surfaces of the pinnules in several rows. There are many large limy needles in the polyp region but none in the stalk and keel. The colour is brown with bluish patches occurring irregularly.

Locality : Nicobars.

Previously recorded from Amboina.

Pteroeides steenstrupi, K  lliker.

An imperfect specimen, the tip of the rachis being broken off.

Total length of colony	80 + mm.
Length of rachis	45 + mm.
Breadth of rachis	37 mm.
Length of stalk	35 mm.

Thickness of stalk	11 mm.
Number of pinnules	30
Number of rays	20-24
Length of pro-rachidial margin of largest pinnule .	16 mm.
Breadth of insertion of largest pinnule . . .	7 mm.
Breadth of largest pinnule	14 mm.
Distance between pinnules	2 mm.

The stalk is conical, with a swelling at the base of the rachis which is heart-shaped when viewed from the meta-rachidial surface but oval from the pro-rachidial. The meta-rachidial surface is covered by the overlapping pinnules except for a short distance near the base. The majority of the pinnules are lateral, but the lower rudimentary forms approach the pro-rachidial surface. They are fan-shaped and contain twenty to twenty-four strong rays composed of two to four spines which project at the margin in a very ragged manner. They are thin and almost transparent. The zooid-plate is marginal and no zooid-streak could be found. The polyps are disposed on either side of the pinnules in five to six rows. There are no limy needles in the polyp-zone nor in the spongy keel and stalk. It is noteworthy that in this specimen the axis extends to the end of the rachis, whereas Kölliker describes a specimen in which the axis ended about the middle.

Locality : Penang.

Previously recorded from Java.

Pteroeides esperi, Herklots.

Two specimens of this species are present in the collection.

Total length of colony	68 mm.	80 mm.
Length of rachis	50 „	50 „
Breadth of rachis	50 „	45 „
Length of stalk	18 „	30 „
Thickness of stalk	8 „	10 „
Number of pinnules	20	21
Number of rays	11-13	12
Length of pro-rachidial margin of largest pinnule .	19 mm.	18 mm.
Breadth of insertion of largest pinnule . . .	7 „	7 „
Breadth of largest pinnule	10 „	15 „
Distance between pinnules	2 „	3 „

This species is very variable. The following are the chief points worthy of note in our specimens. The stem and keel are very hard but contain no limy needles. Both the pro-rachidial and meta-rachidial surfaces are free throughout their entire length. The pinnules are thin and almost sickle-shaped ; the

lower rudimentary forms are scalpel-shaped and approach the pro-rachidial surface. The rays are eleven to thirteen in number and consist of two to four spines projecting in some cases 3.5 mm. The polyps are disposed on both sides of the pinnules in five to six rows extending about half-way down. No zooid-streak was discernible. There are numerous small limy needles in the polyp region. The zooid-plate is marginal and distinct, extending, especially along the rays, well into the polyp-zone.

Localities : Muttah River ; Hughli Delta ; Sandheads ; R. Hughli.

Previously recorded from Java, Philippines, Sumatra, Salatiga, Batavia, 6-10 fathoms.

***Pteroeides esperi*, Herklots, var. *armatum*, nov.**

A single large colony with the following measurements :—

Total length of colony	115 mm.
Length of rachis	80 mm.
Breadth of rachis	65 mm.
Length of stalk	35 mm.
Thickness of stalk	13 mm.
Number of pinnules	32
Number of rays	14
Length of pro-rachidial margin of largest pinnule	25 mm.
Breadth of insertion of largest pinnule	7 mm.
Breadth of largest pinnule	17 mm.
Distance between pinnules	2 mm.

This specimen agrees generally with *P. esperi*, Herklots, but we cannot identify it with any of Kölliker's varieties, *viz.*, *typicum*, *latifolium*, *molle* and *angustifolium*.

The stalk is conical and tapers gradually towards the base. The pinnules overlap, and cover the meta-rachidial surface except for a small triangular portion at the base of the rachis, but the pro-rachidial surface is entirely free. The pinnules are fairly thick and fan-shaped, and there is a slight cushion at the pro-rachidial insertion. The rays are broad and strong, consisting of two to four spines which project beyond the margin making it markedly serrated. The zooid-plate is marginal and extends far into the polyp region, especially along the rays. The polyps are numerous, especially on the upper side of the pinnules ; on the lower side there are three to four rows. The body of the polyps is brownish-black and this gives the characteristic colour to the colony. The tentacles are white. No zooid-streak could be seen.

The general colour is yellowish, but green and brownish-black spots occur on the stalk and keel.

Locality : Andamans.

Family VERETILLIDÆ.

Sub-family Cavernularinæ.

- Cavernularia elegans*, Herklots.
 „ *obesa*, Valenciennes.
 „ *lütkenii*, Kölliker.
 „ *orientalis*, n. sp.
 „ *andamanensis*, n. sp.
Parabelemnion indicum, n. gen. et sp.

Sub-family Lituarinæ.

- Lituarium phalloides*, [Pallas].
 „ *hicksoni*, n. sp.
Policella australis, Gray.

GENUS CAVERNULARIA, Valenciennes.

This genus is distinguished from *Styloblemnion*, Kölliker, by the absence of spicules in the polyps. Kölliker recognised four species and other two have since been added. Neither of these, however, seems to us to be distinct. *C. madeirensis*, Studer, differs from *C. obesa*, Val., only in the size and small number of the polyps, but the study of a large number of specimens from different localities has convinced us of the great variability of the latter species both in these and other characters, so that we would suggest the abolition of *C. madeirensis* as a type distinct from *C. obesa*. Again, *C. habereri*, Moroff, is distinguished from *C. lütkenii*, Kölliker, (1) by the presence of a rudimentary stalk; (2) by its furrowed appearance; and (3) by the grouping of zooids in rows. In this collection are a number of specimens which we have no hesitation in placing in *C. lütkenii*, and which show all stages of transition as to these three characters; in fact we are inclined to the belief that at any rate the last two differences are the result of contraction during death. For these and other reasons we regard *C. habereri* as a form of the variable species *C. lütkenii*.

To the genus we have added two new species which are quite different from those already described, especially with regard to spiculation. Their place in classification will be seen in the following table:—

(A) Without axis:—

- | | | |
|---|-----|-------------------------------------|
| (a) Stalk without needles in the interior | . | <i>C. elegans</i> , Herklots. |
| (b) Stalk with needles in the interior | . . | <i>C. obesa</i> , Val. ¹ |

(B) With axis:—

- | | | |
|---|-----------|------------------------|
| (a) Axis very short, lying at end of stalk or | | |
| absent | | <i>C. glans</i> , Val. |

¹ Including *C. madeirensis*, Studer.

- (b) Axis longer, spindle-shaped, lying at boundary of stalk and club or passing halfway up the club *C. lütkenii*, Kölliker.¹
- (c) Axis spindle-shaped, occupying lower half of club and passing into the stalk *C. orientalis*, n. sp.
- (d) Axis quadrangular, occupying the whole length of the club *C. andamanensis*, n. sp.

Cavernularia elegans, Herklots.

Numerous specimens of this species occur in the collection from various localities. They all present the general features which characterise the species, but differ from them and from one another in certain respects, *e.g.* (1) relative length and breadth of the polyp-bearing portion and the stalk; (2) the relative proportions of the polyp-bearing region of the several colonies; (3) the distance between the polyps and the size of the polyps, and (4) colour. The spiculation is also a matter of some difficulty, the range of variation both in the shapes of spicules and in their dimensions being perhaps greater than in any other species we have examined. The following localities are here represented: Orissa Coast; Sandheads (A. Milner and J. Barnet); Tavoy; Karachi; Chilka Bight, Orissa Coast (J. H. Row). Not only do the specimens differ from the various localities, but there are also marked differences among the specimens from the same locality.

Previously recorded from Japan.

Great variability as to size and number of polyps, arrangement of siphonozooids and spiculation.

Cavernularia obesa, Valenciennes.

In the collection there are a number of specimens which exhibit certain differences in detail, but which we include in the above very variable species. The following are the measurements of some of the colonies:—

Total length of colony	. . .	100 mm.	85 mm.	58 mm.	39 mm.	40 mm.
Length of trunk	. . .	85 "	75 "	50 "	32 "	34 "
Breadth of trunk	. . .	13 "	15 "	15 "	11 "	11 "
Length of stalk	. . .	15 "	10 "	8 "	7 "	6 "
Breadth of stalk	. . .	9 "	11 "	9.5 "	7 "	6 "

The nature of the canals and partitions agrees closely with the description given by Kölliker. In the interior of the stalk there are abundant needles, but there is no trace of an axis. The retracted polyps appear in some as minute specks, while in others they are present as small circles 1 mm. in diameter, in

¹ Including *C. habereri*, Moroff.

the interior of which a stellate figure can be discerned. In the majority of the specimens they are continued down to the origin of the stalk, but in others only siphonozooids can be seen in this region. The polyps are separated by distances varying from 1.5 mm. to 3.5 mm. The specimens with more distant polyps would fall into Studer's *C. madeirensis*, but in the essential points they do not differ from *C. obesa*, so that after taking into consideration the variability of the species we rank the two sets under the title *C. obesa*, Val. The siphonozooids present the same differences of size. In some cases they are arranged apparently in longitudinal rows, in others in transverse rows, in a third type irregularly. Some of the stalks are smooth while others have longitudinal ridges and furrows. The arrangement of the siphonozooids and the ridging of the surface cannot be regarded as of any specific value, being for the most part due to the state of contraction.

In one of the specimens a small offshoot arises from the trunk near its junction with the stalk.

The spicules, both in types and measurements, agree on the whole with Kölliker's description, but here as in other species of *Cavernularia* we must note a marked degree of variation.

The colour of the colonies is creamy-white or a light grey with darker polyps.

Localities : Orissa Coast, Marine Survey ; Palk Strait, Marine Survey.

Previously recorded from Pulo Penang, Bay of Bengal, Indian Ocean, Gulf of Manaar and Cheval Paar.

Cavernularia lütkenii, Kölliker.

A number of specimens showing graded variations comparable to those of *C. obesa*. The following measurements were taken :—

Total length of colony	. . .	43 mm.	23 mm.	30 mm.	20 mm.	29 mm.	23 mm.
Length of trunk	. . .	33 "	21 "	20 "	15 "	15 "	13 "
Breadth of trunk	. . .	25 "	24 "	18 "	9 "	14 "	12 "
Length of stalk	. . .	10 "	2 "	10 "	5 "	14 "	10 "
Breadth of stalk	. . .	9 "	2 "	3 "	3 "	3 "	4 "

Some of the colonies are flattened in one plane but the majority are globular. The nature and length of the stalk are worthy of note. *C. habereri*, Moroff, was distinguished from *C. lütkenii* by the rudimentary nature of the stalk. In one of the largest specimens in this collection the stalk is reduced to a minimum, while in some of the smaller specimens it is almost as long as the trunk. The other differences are (1) furrowed nature of stalk, and (2) siphonozooids in longitudinal rows. But, as we have noted in the case of *C. obesa*, a survey of a number of specimens shows that these are only relative differences and not a basis for specific distinction.

The polyps and spicules show marked variability as in *C. obesa*, but agree on the whole with Kölliker's type specimens. It is interesting to note that, in all the specimens we examined, the change in position of the axis with regard to the partition walls in the trunk and stalk is exactly in accordance with Kölliker's description.

The colour is pale yellow, with transparent polyps like those of *Aleyonium digitatum*, but in two specimens (those with the long stalks) it is purplish, even in the body of the polyps, while the tentacles are pinkish-white.

Localities: Orissa Coast, Marine Survey; Sandheads, R. Hughli; also Calicut.

Previously recorded from Bay of Bengal.

Cavernularia orientalis, n. sp. Plate IX. figs. 1a, 1b.

This new species is represented by one complete specimen whose measurements are as follows:—

Total length of colony	. . .	65 mm.
Length of trunk	. . .	47 mm.
Breadth of trunk	. . .	15 mm.
Length of stalk	. . .	18 mm.
Breadth of stalk	. . .	6 mm.

The axis extends from about the middle of the stalk to within 27 mm. of the tip of the trunk. A cross-section of the stalk shows a circular cavity with two thick diametrically placed partition walls dividing it into four equal longitudinal canals. In the trunk, however, the position of the walls is different. The cavity is oval in shape, and parallel to the short axis there are two dividing partitions; joining the mid-points of these is the *septum transversale*. The spindle-shaped axis is enclosed, at the middle of the septum, within the two component membranes. In the upper portion of the trunk the same three partition walls are distinctly visible, though more delicate than in the stalk.

There are abundant spicules in the canal walls both in the stalk and in the trunk.

The polyps are all withdrawn and the whole colony is very much contracted. The position of the polyps is marked by pit-like depressions which are about 1 mm. apart. There are abundant siphonozooids with apparently no regular arrangement. Their openings appear as elongated slits. A section of the trunk shows large internal cavities with well-developed mesenteries bearing small ova, but the polyp occupies only a small portion near the surface. Numerous solenia are also seen traversing the colony in all directions, connecting the polyps and apparently also the siphonozooids with the large central canals.

The polyps diminish in number towards the base of the trunk.

The spicules are very characteristic and mark this species as distinct from *C. lütkenii*, to which it is most closely allied. All are smooth and hyaline and many show very clearly the lines of growth (see fig.). The following are *some* of the types with measurements in millimetres :—

(A) Trunk :—

- (a) Cylindrical forms, 0.2×0.03 ; 0.125×0.02 .
- (b) Cylindrical with epiphysis-like terminations, 0.225×0.03 ; 0.2×0.02 .
- (c) Cylindrical with broad bifurcations at one end, some of which are almost T-shaped, 0.35×0.08 ; 0.3×0.06 ; 0.225×0.035 .
- (d) Cylindrical with knob at one end and bifurcation at the other, 0.35×0.075 ; 0.3×0.06 ; 0.25×0.055 .
- (e) Bifurcated at both ends, the smaller forms resembling vertebræ, 0.4×0.1 ; 0.35×0.075 ; 0.2×0.04 .
- (f) Flattened forms with rings of growth like the shell of *Solen*, 0.3×0.025 ; 0.25×0.02 .

There are numerous irregular and intermediate types ; in some the bifurcations are smooth, in others they are again sub-divided.

(B) Stalk :—

- (a) Short spindles with rather rounded ends, 0.1×0.02 ; 0.075×0.02 .
- (b) Spindle-shaped, broader at the middle, resembling “navicellæ,” 0.125×0.03 ; 0.12×0.035 .
- (c) Cylinders with a conical termination, 0.15×0.04 ; 0.15×0.02 .
- (d) Spindle-shaped with one-half expanded and bifurcated, 0.175×0.03 ; 0.175×0.045 ; 0.15×0.02 .
- (e) Quartettes, 0.15×0.04 ; 0.15×0.03 .
- (f) Irregular and intermediate types, 0.2×0.1 ; 0.175×0.04 ; 0.15×0.03 .

In *C. lütkenii* the ends of the spicules are never divided.

The colour of the colony is creamy-white.

Locality : Orissa Coast, Marine Survey.

***Cavernularia andamanensis*, n. sp. Plate IX. fig. 3.**

Two incomplete colonies representing only the upper portion of the trunk. Both are cylindrical in shape, and are 28 mm. and 21 mm. in length and 10 mm. and 6.5 mm. in diameter respectively. The axis extends to the very tip of the colony and is quadrangular in cross-section, with the sides slightly incurved. In the larger specimen it is 1.75 mm. broad, in the smaller 1.25 mm.

The colonies are different in texture and in degree of contraction. The larger is very soft and spongy and all the polyps are withdrawn. The polyps occur almost uniformly all over the surface. The openings are circular and

about 1 mm. in diameter. The siphonozooids are densely packed, and have no definite arrangement. The smaller specimen is of a firmer consistence and very few of the polyps are retracted. The siphonozooids are smaller but equally numerous.

The polyps are about 6 mm. in length and have a diameter of 0.75 mm. The tentacles are 1 mm. long. They are very broad and transparent, and have two rows of about 15 pinnules on each side. The polyps are simply retracted by well-developed muscles on the mesenteries so that the tips of the tentacles are close together just under the circular aperture which is closed by a transparent membrane. The position of the siphonozooids is marked by small circular openings covered by a hyaline film showing a radiate structure, evidently the muscles which close the aperture. No trace of tentacles could be found.

From the nature of the specimens it was impossible to ascertain the position of the septa, but the same system of solenia was observed as in *C. orientalis*, n. sp.

The spicules of the trunk are smooth and hyaline and show markedly the lines of growth. The following are *some* of the types with measurements in millimetres :—

(a) Capstan-like with narrow constriction or like two cones joined by their apices, 0.125×0.025 ; 0.075×0.025 .

(b) Cylindrical with bifurcation at one end—some almost T-shaped, 0.25×0.125 ; 0.2×0.1 ; 0.15×0.075 .

(c) Capstan-like with bifurcations at both ends, 0.3×0.1 ; 0.125×0.05 .

(d) Capstan-like with three prongs at one end and two at the other, 0.3×0.125 ; 0.2×0.1 ; 0.125×0.075 .

(e) Capstan-like with four prongs at one end and two at the other, 0.3×0.15 ; 0.225×0.125 ; 0.1×0.05 .

(f) Some have an x-shaped marking dividing them into six rays, the middle pair being very short (reminding one of the arrangement of the tentacles in an Antipatharian polyp with the lowly inserted sagittal pair), 0.275×0.175 ; 0.15×0.05 .

This species is distinguished from *C. glans*, Val., and *C. lütkenii*, Kölliker, by the nature and length of the axis and also by the types of spicules. From *C. orientalis*, n. sp., it is distinguished by the axis and in a less degree by the spicules.

The colour is creamy-white.

Localities : Andamans, Marine Survey ; Orissa Coast.

GENUS PARABELEMNON, n.

An elongated and cylindrical Veretillid with the rachis longer than the stalk ; autozooids distributed over the surface, the interstices covered with

siphonozooids leaving no bare streak; verrucæ bird-nest-like, formed of long spicules arranged in four groups and terminating in four triangular points; rachis gradually increasing in thickness from below upwards; stalk cylindrical with a slight swelling on the lower half; axis quadrangular with a shallow groove on the para-rachidial surfaces; spicules abundant both in the rachis and in the cutis of the stalk; those of the stalk rough scales, those in the rachis typically smooth spindles and cylinders with many branched and irregular forms.

This new genus is allied to *Styloblemmon*, Kölliker, and *Styloblemnoides*, Thomson and Henderson; the following table gives the chief points of difference:—

Styloblemmon.	Styloblemnoides.	Parablemmon.
Axis cylindrical. Rachis about as long or longer than the stalk.	Axis square in section.	Axis square in section. Rachis longer than the stalk.
Length of colony, 38 mm. Breadth of rachis, 7 mm.	Length of rachis, 32.5 mm. Breadth of rachis, 2.8 mm. Calyces with eight double rows of spicules.	Length of colony, 190 mm. Breadth of rachis, 4 mm. Calyces with spicules in four groups with four triangular projecting points.
Thickness of axis, 0.5 mm.	Thickness of axis, 0.85 mm. Polyps in two intersecting (but not exact) spirals.	Thickness of axis, 1.2 mm. Polyps irregularly arranged round the whole of the rachis.
Spicules: smooth cylinders often with median constriction; spindles.	Spicules: rod-like.	Spicules: (A) Stalk: Rough scales; (B) Rachis: Spindles, cylinders and branched forms.
Largest needles 0.14 mm. in length, mostly 0.11 mm.	Needles about 0.25 mm. in length.	Scales, 0.2×0.09 . Spindles, 0.3×0.03 . Cylinders, 0.25×0.025 . Irregular forms, 0.45×0.06 .

***Parablemmon indicum*, n. sp.**

Plate III. figs. 6 and 7; Plate IX. fig. 4.

A complete, well-preserved colony with the following measurements in millimetres:—

Total length of colony	. . .	190 mm.
Length of rachis	. . .	110 mm.
Maximum breadth of rachis	. . .	4 mm.
Length of stalk	. . .	80 mm.
Breadth of stalk	. . .	2.8 mm.
Breadth of axis	. . .	1.2 mm.

The axis extends from end to end of the colony; it is square in section with a deep groove on each of the para-rachidial surfaces; the breadth is almost uniform throughout. The stalk is cylindrical, but tapers gradually at the lower end, the last 30 mm. of which is occupied by a slight swelling. The rachis

increases in thickness from below upwards and ends bluntly. The polyps occur all over the rachis but apparently with no regular arrangement. They are completely retractile within fairly definite verrucæ formed by longitudinally disposed spicules arranged in four groups which terminate in four triangular points. The verrucæ resemble elongated swallow-nests; some project markedly, but others, especially in the lower part, owing to internal contraction, are sunk into pit-like depressions and are almost level with the coenenchyma. Siphonozoids fill up the interstices so that no bare streak is left. The spicules form a dense armature on the rachis especially around the polyps; they are also very abundant in the cutis of the stalk. The following are some of the typical measurements length by breadth in millimetres:—

(A) Stalk:—

(a) Rough scales, some with comparatively regular edges, 0.2×0.09 ; 0.15×0.06 ; 0.1×0.05 ; 0.08×0.03 .

(b) Scales with very ragged edges and covered with small warts, 0.2×0.1 ; 0.14×0.1 ; 0.1×0.06 .

(B) Rachis—These are smooth; they are typically spindles and cylinders, but many divergent forms arise by branching:—

(a) Spindles, 0.3×0.03 ; 0.26×0.02 .

(b) Cylinders, 0.25×0.025 ; 0.2×0.02 .

(c) Irregular forms, 0.45×0.06 ; 0.4×0.06 ; 0.3×0.04 ; 0.2×0.03 .

The general colour of the colony is light brown, but the siphonozoids stud it with blue.

Locality: Unknown, Marine Survey.

GENUS LITUARIA, Val.

Lituaría phalloïdes, [Pallas].

We have referred to this species several colonies which agree on the whole with Kölliker's description, though exhibiting certain differences noted below. The following are the measurements of some of the colonies in millimetres:—

Total length of colony	.	.	210	150	150	135	130	110	100	75	70+
Length of rachis	.	.	125	85	75	70	55	55	45	30	65
Maximum breadth of rachis	.	.	5	4.5	7	5.5	5	5	4.5	3	6
Thickness of stalk	.	.	4	3.5	?	3	3	3	2.5	2	?

The colonies gradually increase in thickness from below upwards and terminate bluntly. None of the specimens are so robust as that described by Kölliker. The rachis is almost quadrangular and the polyps are distributed apparently all round. The coenenchyma appears pitted, especially in the younger forms, owing to the depressions in the axis in which the polyps are embedded. The general colour is white (except in one colony where it is light brown), but

the bluish-green polyps stand out in marked contrast. The stalk is smooth and hard and bears two swellings, one close to the base, the other a short distance below the rachis. The axis extends from end to end of the colony and is very distinctive. In the lower part of the stalk it is flexible and almost cylindrical, often curved back within the coenenchyma. In the upper part of the stalk it is four-cornered with a groove on each surface, those on the pro- and meta-rachidial surfaces being much deeper than the other two. These are continued throughout the whole length of the rachis but the para-rachidials disappear, and are replaced by a characteristic honey-comb structure in the recesses of which the polyps are embedded. This gives a distinctive contour especially to the younger colonies.

In one of the specimens the stalk has been broken off at the base of the rachis and the fracture has been quite overgrown by the coenenchyma.

Large ova are present in several of the more mature colonies.

The following are some of the types of spicules with measurements in millimetres :—

- (a) Rough plates, 0.1×0.03 ; 0.09×0.025 .
- (b) Smooth rods, 0.08×0.01 ; 0.07×0.075 .
- (c) Minute crosses, 0.04×0.04 .

From the Persian Gulf there are also a number of very young stages (largest 25 mm. long) in which the characteristic type of axis is visible through the thin coenenchyma of the rachis. In these the stalk is often three times as long as the rachis and tapers to a fine point. The rachis itself often terminates conically.

Localities : Andamans ; Persian Gulf, 3 fathoms.

Lituaría hicksoni, n. sp. Plate IX. fig. 2; Plate VI. figs. 7 and 8.

We have referred to *Lituaría* several beautiful and in many ways unique colonies which show the essential features of the genus, but differ in certain details. The axis tapers towards the top of the rachis, and is without the characteristic honeycomb structure seen in *L. phalloides*; and the types of spicules are slightly different. As these differences do not seem to us to justify the establishment of a new genus, we would emend the diagnosis, founded on a single colony, so as to include our specimens.

The following are the measurements in millimetres of some of the colonies :—

Total length of colony	.	.	38	38	37	35	34	28	27	23
Length of rachis	.	.	21	20	20	18	17	15	15	13
Breadth of rachis	.	.	5	6	5.5	3.5	5.5	3.5	5	5
Thickness of stalk	.	.	3	2.5	3	3	3	2.5	3	2.5

The axis extends throughout the entire length of the colony. Towards both ends it tapers slightly and is almost cylindrical, but in the rachis it is four-

cornered with a deep groove on two of the surfaces while the other two faces are convex. The polyps are large and mostly colourless (in some specimens bluish). They are distributed irregularly over the whole rachis, separated by distances of about 2 mm. They are entirely retractile and when withdrawn they leave large cup-shaped verrucae the openings of which are directed upwards. There are abundant spicules arranged in eight bands on the verrucae; this feature is most marked in those with bluish polyps. No definite arrangement of the spicules in the bands is to be seen. The tentacles are broad and spatula-shaped, and bear a single row of short thick pinnules; they contain no spicules.

The siphonozooids are brown or blue, and occur irregularly among the polyps; they are easily seen with the naked eye and vary in number in the different specimens. They are continued in a somewhat spiral manner in the lower part of the rachis beyond the polyp region; sometimes they are elevated and papilla-like and are supported by a circlet of spicules. The eight radiating muscle banners are well developed.

The spicules include elongated capstans, sometimes irregular at the tips, or like irregular cervical vertebrae; and crosses are also abundant. A frequently occurring measurement of length and breadth in mm. is 0.2×0.1 .

The coenenchyma is rather hard and tough and is abundantly supplied with spicules. Numerous ova occur in the larger colonies.

Localities: Station 182, off Indus Delta, 35 fathoms; Station 344, Persian Gulf, 31 fathoms; off Orissa Coast, 68 fathoms.

Emended Diagnosis of Lituarina.

The diagnosis may read:—

The colony is of the Veretillid type with a club-like polyparum surrounded by relatively distant autozooids with numerous wart-like siphonozooids in the interspaces; the axis, which extends throughout the entire length of the colony, is in the rachis-region roughly quadrangular and grooved, and tapers to the tip, or it is irregularly pitted with recesses in which the polyps are embedded and has this structure continued to the tip; the spicules, which are abundant on the general surface of the polyparum and in the verrucae (but absent from the autozooids themselves), may be:—

- (a) "Kurz, bisquit- oder linsenförmig" (Kölliker's *L. phalloides*);
- (b) rough plates, smooth rods and minute crosses ("Investigator" specimens of *L. phalloides*); or
- (c) elongated capstans sometimes with irregular ends, or like elongated cervical vertebrae, with crosses in addition.

GENUS POLICELLA, Gray.

Policella australis, Gray.

With this imperfectly described species we have identified a portion of a colony consisting of part of the rachis, 30 mm. in length, from which the axis projects about 20 mm. The diameter of the rachis is 6 mm. The axis extends to the very tip of the colony; it is quadrangular in section with each surface equally concave; the breadth is almost uniformly 1.5 mm. The polyps are wholly retractile within a soft cup-shaped verruca-portion 1 mm. in height and 1 mm. in diameter. The body of the polyp is about 1.5 mm. in length. The tentacles are 1.5 mm. long; they are very broad and bear two single rows of long pinnules. There are eight distinct bands on the verrucæ which, when the latter are closed, form eight lobes around the circular opening. These are continued into the polyps and appear as distinct ridges and furrows, the ridges corresponding to the tentacles. There is a marked inequality in the size of the polyps, all stages of growth being clearly visible; some with minute tentacles scarcely protruding beyond the surface of the cœnenchyma are hardly larger than the siphonozoids. Numerous small circular siphonozoids, showing an eight-rayed figure, are prominent among the larger polyps. The following are some of the measurements of spicules in millimetres:—

(a) Biscuit-shaped, 0.1×0.05 ; 0.09×0.05 ; 0.08×0.04 .

(b) Almost square forms with x-shaped marking, 0.08×0.06 ; 0.06×0.06 .

The general colour is bluish but the tentacles are yellowish-brown; in some cases the pinnules are pale yellow; the siphonozoids are marked by eight white muscular bands radiating from the circular opening.

This species differs from *P. manillensis* in (1) the much smaller size of the polyps (1.5 mm. instead of 12 mm.); (2) the presence of spicules in the cortex of the club; and (3) the shape of the spicules.

Locality: Andamans.

Previously recorded from Shark's Bay, Australia.

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EXPLANATION OF PLATES.

PLATE I.

- Fig. 1. *Kophobelemnon intermedium*, n. sp. Tip of colony enlarged, pro-rachidial surface ($\times 6$).
 „ 2. *Acis ulex*, n. sp. Complete colony, nat. size.
 „ 3. *Kophobelemnon intermedium*, n. sp. Tip of colony enlarged, meta-rachidial surface ($\times 6$).
 „ 4. *Echinogorgia flexilis*, n. sp. Twig enlarged ($\times 9$).
 „ 5. *Acis ulex*, n. sp. Portion of twig enlarged ($\times 12$).
 „ 6. *Acis pustulata*, Wright and Studer. Terminal portion of twig enlarged ($\times 10$) front view.
 „ 7. „ „ „ „ „ „ „ „ „ ($\times 10$) back „
 „ 8. *Echinomuricea andamanensis*, n. sp. Twig enlarged ($\times 15$).
 „ 9. *Echinomuricea reticulata*. Terminal portion of twig enlarged ($\times 12$).

PLATE II.

- | | | |
|----------|--|--|
| Fig. 1. | <i>Pteroeides punctatum</i> , n. sp. | Pinnule enlarged ($\times 5$). |
| " 2. | <i>Anthogorgia racemosa</i> , n. sp. | Small portion enlarged ($\times 9$). |
| " 3. | " " " | Twig, nat. size. |
| " 4. | <i>Pteroeides punctatum</i> , n. sp. | Complete colony, nat. size. |
| " 5. | <i>Psammogorgia ridleyi</i> , n. sp. | |
| " 6. | <i>Pteroeides andamanense</i> , n. sp. | Pinnule enlarged ($\times 6$). |
| " 7. (a) | <i>Suberogorgia ornata</i> , n. sp. | Portion enlarged ($\times 2$). |
| " 7. (b) | " " " | Portion enlarged ($\times 11$). |
| " 8. | <i>Anthogorgia glomerata</i> , n. sp. | Portion enlarged ($\times 2$). |

PLATE III.

- Fig. 1. *Muricella arborea*, n. sp. Portion enlarged ($\times 10$).
 " 2. *Echinomuricea indica*, n. sp. Colony, nat. size.
 " 3. " " " Portion enlarged ($\times 8$).
 " 4. *Acamptogorgia tenuis*, n. sp. Twig enlarged ($\times 12$).
 " 5. *Muricella arborea*, n. sp. Portion enlarged ($\times 2$).
 " 6. *Parabelemnion indicum*, n. g. et sp. Tip of colony enlarged ($\times 8$).
 " 7. " " " " Colony, nat. size.
 " 8. *Acamptogorgia tenuis*, n. sp. Portion enlarged ($\times 2$).
 " 9. *Echinogorgia pseudosassapo*, K  lliker. Tip of twig enlarged ($\times 9$).
 " 10. *Calicogorgia tenuis*, n. sp. Portion enlarged ($\times 10$).
 " 11. *Anthogorgia glomerata*, n. sp. Portion enlarged ($\times 10$).
 " 12. (a) *Siphonogorgia media*, n. sp. Complete colony ($\times 1\frac{1}{2}$).
 " 12. (b) " " " Polyp closed ($\times 7$).
 " 12. (c) " " " Polyp partially open ($\times 7$).

PLATE IV.

- Fig. 1. *Echinogorgia intermedia*, Studer. Twig enlarged ($\times 2$).
 „ 2. *Eumuricea splendens*, n. sp. Tip of twig enlarged ($\times 8$).
 „ 3. „ „ „ Colony, nat. size.
 „ 4. *Acis rigida*, n. sp. Portion enlarged ($\times 2$).
 „ 5. *Nicella reticulata*, n. sp. Tip of twig enlarged ($\times 5$).
 „ 6. *Echinomuricea uliginosa*, n. sp. Colony, nat. size.
 „ 7. „ „ „ Portion enlarged ($\times 12$).
 „ 8. *Echinomuricea macrospiculata*, n. sp. Part enlarged ($\times 8$).
 „ 9. *Acis rigida*, n. sp. Portion enlarged ($\times 8$).
 „ 10. *Verrucella flexuosa*, Klunzinger. Portion enlarged ($\times 2$).
 „ 11. *Echinogorgia intermedia*, Studer. Twig enlarged ($\times 7$).

PLATE V.

- Fig. 1. *Scytalium martensii*, Kölliker. Portion enlarged ($\times 14$).
 „ 2. *Melitodes philippinensis*, Wright and Studer. Part enlarged ($\times 2$) dorsal view.
 „ 3. *Melitodes ornata*, n. sp. Portion enlarged ($\times 1\frac{1}{2}$).
 „ 4. *Melitodes philippinensis*, Wright and Studer. Same part enlarged ($\times 2$) ventral view.
 „ 5. *Scytalium martensii*, Kölliker. Portion enlarged ($\times 14$).
 „ 6. *Nicella pustulosa*, n. sp. Tip of twig enlarged ($\times 6$).
 „ 7. *Echinogorgia macrospiculata*, n. sp. Complete colony ($\times 1\frac{1}{2}$).
 „ 8. *Muricella robusta*, n. sp. Tip of twig enlarged ($\times 12$).
 „ 9. *Melitodes ornata*, n. sp. Tip of twig enlarged.
 „ 10. (a) *Muricella complanata*, Wright and Studer. Purple type, twig ($\times 1\frac{1}{2}$).
 „ 10. (b) „ „ „ „ „ Pink type, twig ($\times 1\frac{1}{2}$).

PLATE VI.

- Fig. 1. *Isis hippuris*, Linnæus. Colony (n.s.).
 „ 2. „ „ „ Section of tip of twig ($\times 10$).
 „ 3. „ „ „ Portion of surface of branch ($\times 14$).
 „ 4. *Bebryce tenuis*, n. sp. Portion enlarged ($\times 7$).
 „ 5. „ „ „ Colony (n.s.).
 „ 6. *Menacella gracilis*, n. sp. Portion enlarged ($\times 7$).
 „ 7. *Lituarina hicksoni*, n. sp. Colony (n.s.).
 „ 8. „ „ „ Tip of colony enlarged ($\times 3$).
 „ 9. *Pteroeides intermedium*, n. sp. Pinnule ($\times 5$).

PLATE VII.

- Fig. 1. *Cactogorgia celosioides*, Simpson. Complete colony ($\times 2$).
 „ 2. „ „ „ Polyp ($\times 10$).
 „ 3. (a) „ „ „ Spicules from the stem.
 „ 3. (b) „ „ „ Spicules from the anthocodæ.
 „ 3. (c) „ „ „ Spicules from the aboral surface of the tentacles.
 „ 4. *Cactogorgia alciformis*, Simpson. Complete colony ($\times 2$).
 „ 5. „ „ „ Polyp ($\times 10$).
 „ 6. (a) „ „ „ Spicules from the stem.
 „ 6. (b) „ „ „ Spicules from the anthocodæ.
 „ 6. (c) „ „ „ Spicules from the aboral surface of the tentacles.

Fig. 7.	<i>Cactogorgia expansa</i> , Simpson.	Complete colony ($\times 1\frac{1}{4}$).
" 8.	" " "	Polyp ($\times 10$).
" 9. (a)	" " "	Spicules from the stem.
" 9. (b)	" " "	Spicules from the anthocodæ.
" 9. (c)	" " "	Spicules from the aboral surface of the tentacles.

PLATE VIII.

- Fig. 1. *Echinogorgia macrospiculata*, n. sp.
 " 2. *Echinomuricea andamanensis*, n. sp.
 " 3. *Echinogorgia ramulosa*, Gray.
 " 4. *Echinomuricea indica*, n. sp.
 " 5. *Echinogorgia intermedia*, Studer.
 " 6. *Echinomuricea reticulata*, n. sp.
 " 7. *Acamptogorgia tenuis*, n. sp.
 " 8. *Gorgonella umbella*, Esper.
 " 9. *Gorgonella granulata*, Esper.
 " 10. *Gorgonella umbella*, Esper.
 " 11. *Nicella pustulosa*, n. sp.
 " 12. *Nicella reticulata*, n. sp.
 " 13. [Inserted by mistake.]
 " 14. *Anthogorgia racemosa*, n. sp.
 " 15. *Eumuricea ramosa*, n. sp.
 " 16. *Menacella gracilis*, n. sp.
 " 17. *Eumuricea splendens*, n. sp.
 " 18. *Muricella arborea*, n. sp.

PLATE IX.

- Fig. 1. (a) *Cavernularia orientalis*, n. sp. Trunk.
 " 1 (b) " " " Stalk.
 " 2. *Lituaria hicksoni*, n. sp.
 " 3. *Cavernularia andamanensis*, n. sp. Trunk.
 " 4. *Parabelemnion indicum*, n. gen. et. sp.
 " 5. (a) *Acis pustulata*, Wright and Studer. Main stem.
 " 5. (b) " " " " " Twig.
 " 6. (a) *Acis ulex*, n. sp. Cœnenchyma.
 " 6. (b) " " " Polyp.
 " 6. (c) " " " Twig.
 " 7. (a) *Siphonogorgia media*, n. sp.
 " 7. (b) " " " "
 " 8. *Siphonogorgia macrospina*, Whitelegge.
 " 9. *Siphonogorgia intermedia*, Studer.
 " 10. (a) *Psammogorgia ridleyi*, n. sp. Base.
 " 10. (b) " " " Twig.
 " 11. *Melitodes ornata*, n. sp.
 " 12. *Melitodes philippinensis*, Wright and Studer.
 " 13. *Plexauroides praelonga* (= *Plexaura praelonga*, Ridley).
 " 14. *Bebryce mollis*, de Philippi.
 " 15. " " " "

PLATE I.

- Fig. 1. *Kophobelemnon intermedium*, n. sp. Tip of colony enlarged, pro-rachidial surface ($\times 6$).
- „ 2. *Acis ulex*, n. sp. Complete colony, nat. size.
- „ 3. *Kophobelemnon intermedium*, n. sp. Tip of colony enlarged, meta-rachidial surface ($\times 6$).
- „ 4. *Echinogorgia flexilis*, n. sp. Twig enlarged ($\times 9$).
- „ 5. *Acis ulex*, n. sp. Portion of twig enlarged ($\times 12$).
- „ 6. *Acis pustulata*, Wright and Studer. Terminal portion of twig enlarged ($\times 10$) front view.
- „ 7. *Acis pustulata*, Wright and Studer. Terminal portion of twig enlarged ($\times 10$) back view.
- „ 8. *Echinomuricea andamanensis*, n. sp. Twig enlarged ($\times 15$).
- „ 9. *Echinomuricea reticulata*. Terminal portion of twig enlarged ($\times 12$).

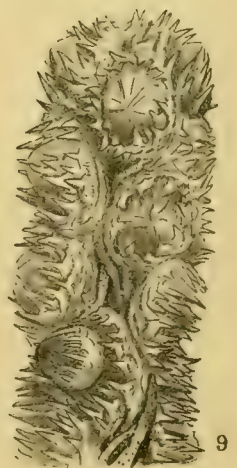


PLATE II.

- Fig. 1. *Pteroeides punctatum*, n. sp. Pinnule enlarged ($\times 5$).
,, 2. *Anthogorgia racemosa*, n. sp. Small portion enlarged ($\times 9$).
,, 3. " " " Twig, nat. size.
,, 4. *Pteroeides punctatum*, n. sp. Complete colony, nat. size.
,, 5. *Psammogorgia ridleyi*, n. sp.
,, 6. *Pteroeides andamanense*, n. sp. Pinnule enlarged ($\times 6$).
,, 7. (a) *Suberogorgia ornata*, n. sp. Portion enlarged ($\times 2$).
,, 7. (b) " " " Portion enlarged ($\times 11$).
,, 8. *Anthogorgia glomerata*, n. sp. Portion enlarged ($\times 2$).

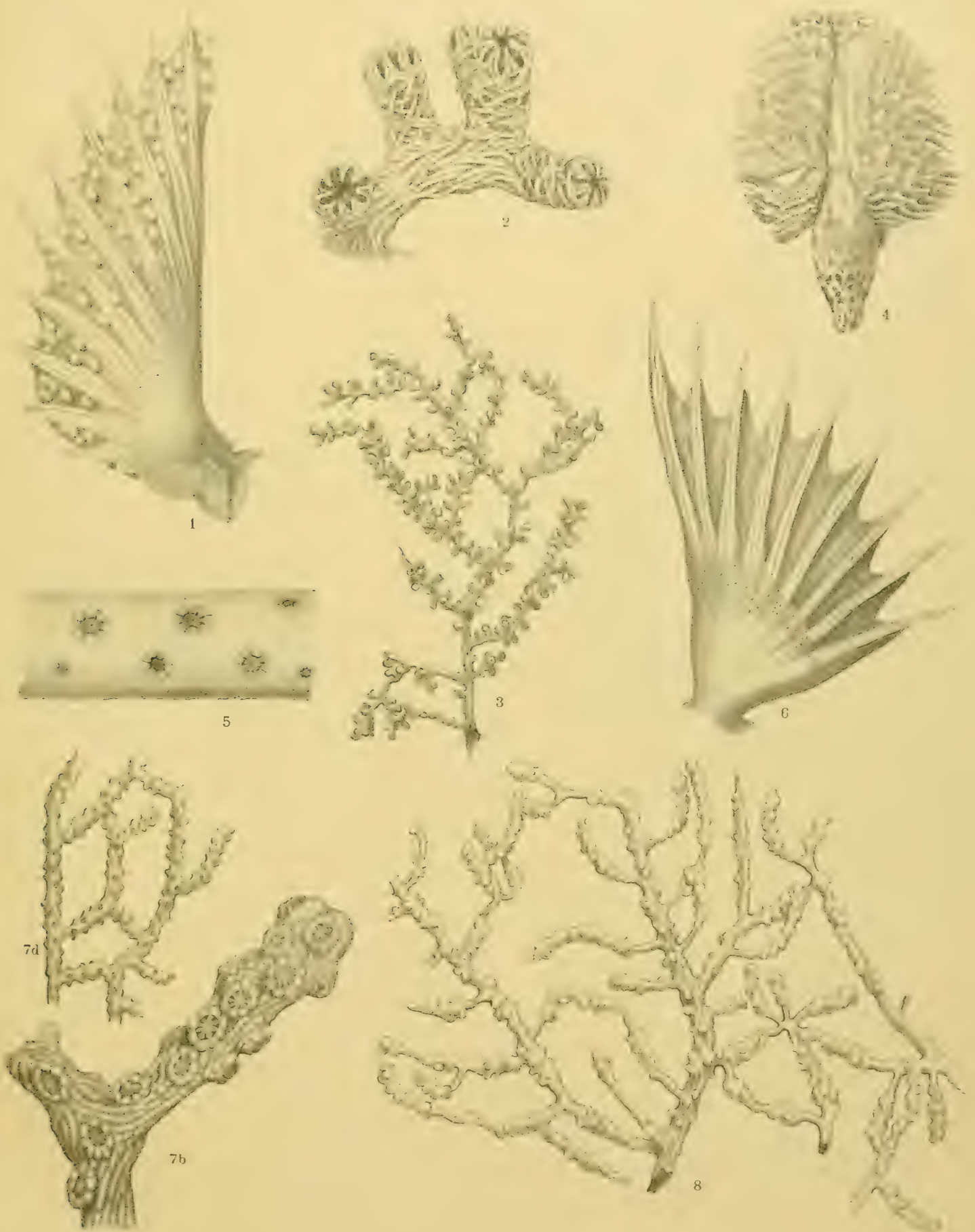


PLATE III.

- Fig. 1. *Muricella arborea*, n. sp. Portion enlarged ($\times 10$).
 „ 2. *Echinomuricea indica*, n. sp. Colony, nat. size.
 „ 3. „ „ „ Portion enlarged ($\times 8$).
 „ 4. *Acamptogorgia tenuis*, n. sp. Twig enlarged ($\times 12$).
 „ 5. *Muricella arborea*, n. sp. Portion enlarged ($\times 2$).
 „ 6. *Parablemnon indicum*, n. g. et sp. Tip of colony enlarged ($\times 8$).
 „ 7. „ „ „ „ Colony, nat. size.
 „ 8. *Acamptogorgia tenuis*, n. sp. Portion enlarged ($\times 2$).
 „ 9. *Echinogorgia pseudosassapo*, K  lliker. Tip of twig enlarged ($\times 9$).
 „ 10. *Calicogorgia tenuis*, n. sp. Portion enlarged ($\times 10$).
 „ 11. *Anthogorgia glomerata*, n. sp. Portion enlarged ($\times 10$).
 „ 12. (a) *Siphonogorgia media*, n. sp. Complete colony ($\times 1\frac{1}{2}$).
 „ 12. (b) „ „ „ Polyp closed ($\times 7$).
 „ 12. (c) „ „ „ Polyp partially open ($\times 7$).

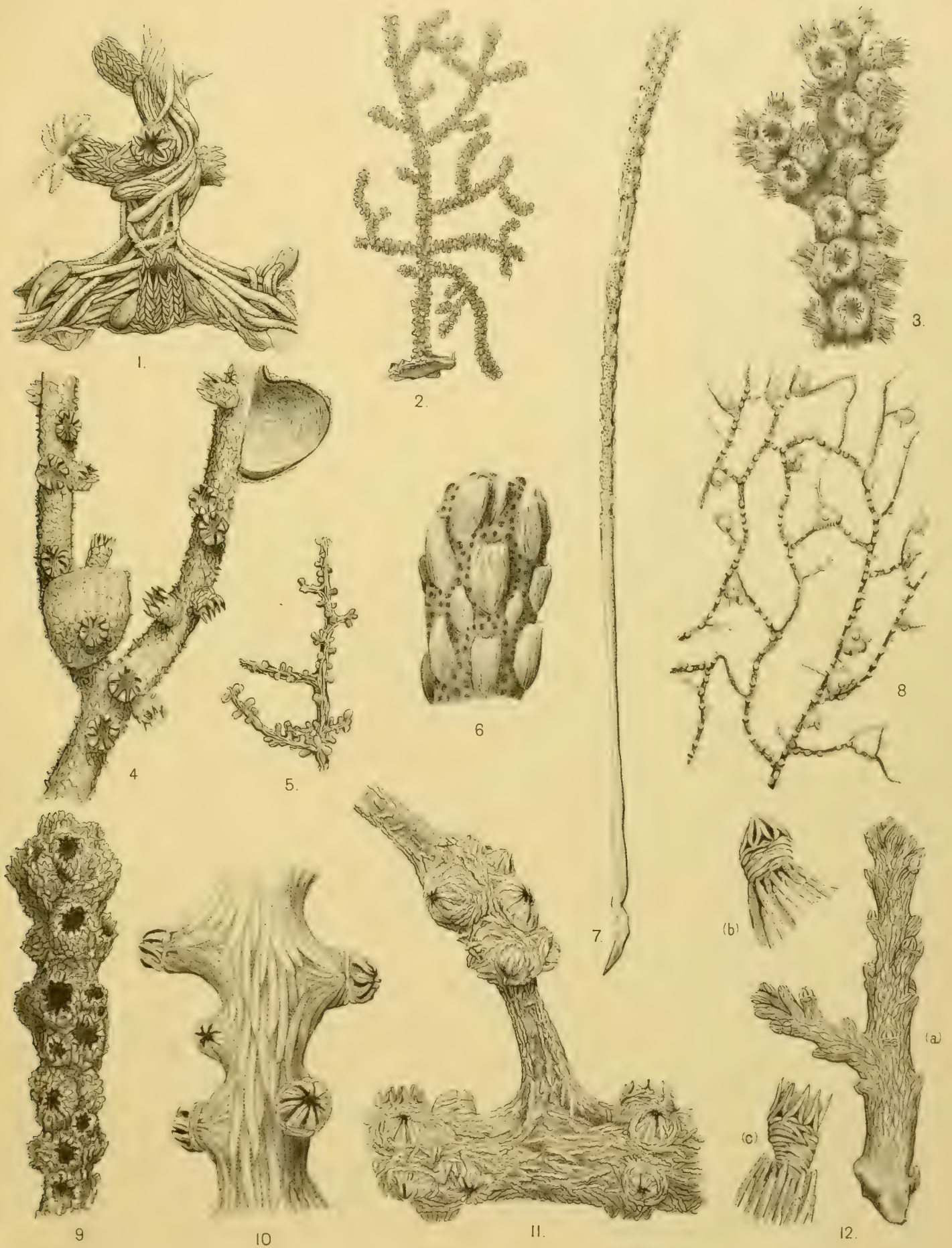


PLATE IV.

- Fig. 1. *Echinogorgia intermedia*, Studer. Twig enlarged ($\times 2$).
,, 2. *Eumuricea splendens*, n. sp. Tip of twig enlarged ($\times 8$).
,, 3. " " " Colony, nat. size.
,, 4. *Acis rigida*, n. sp. Portion enlarged ($\times 2$).
,, 5. *Nicella reticulata*, n. sp. Tip of twig enlarged ($\times 5$).
,, 6. *Echinomuricea uliginosa*, n. sp. Colony, nat. size.
,, 7. " " " Portion enlarged ($\times 12$).
,, 8. *Echinomuricea macrospiculata*, n. sp. Part enlarged ($\times 8$).
,, 9. *Acis rigida*, n. sp. Portion enlarged ($\times 8$).
,, 10. *Verrucella flexuosa*, Klunzinger. Portion enlarged ($\times 2$).
,, 11. *Echinogorgia intermedia*, Studer. Twig enlarged ($\times 7$).



PLATE V.

- Fig. 1. *Scytalium martensii*, K  lliker. Portion enlarged ($\times 14$).
,, 2. *Melitodes philippinensis*, Wright and Studer. Part enlarged ($\times 2$) dorsal view.
,, 3. *Melitodes ornata*, n. sp. Portion enlarged ($\times 1\frac{1}{2}$).
,, 4. *Melitodes philippinensis*, Wright and Studer. Same part enlarged ($\times 2$) ventral view.
,, 5. *Scytalium martensii*, K  lliker. Portion enlarged ($\times 14$).
,, 6. *Nicella pustulosa*, n. sp. Tip of twig enlarged ($\times 6$).
,, 7. *Echinogorgia macrospiculata*, n. sp. Complete colony ($\times 1\frac{1}{2}$).
,, 8. *Muricella robusta*, n. sp. Tip of twig enlarged ($\times 12$).
,, 9. *Melitodes ornata*, n. sp. Tip of twig enlarged.
,, 10. (a) *Muricella complanata*, Wright and Studer. Purple type, twig ($\times 1\frac{1}{2}$).
,, 10. (b) *Muricella complanata*, Wright and Studer. Pink type, twig ($\times 1\frac{1}{2}$).

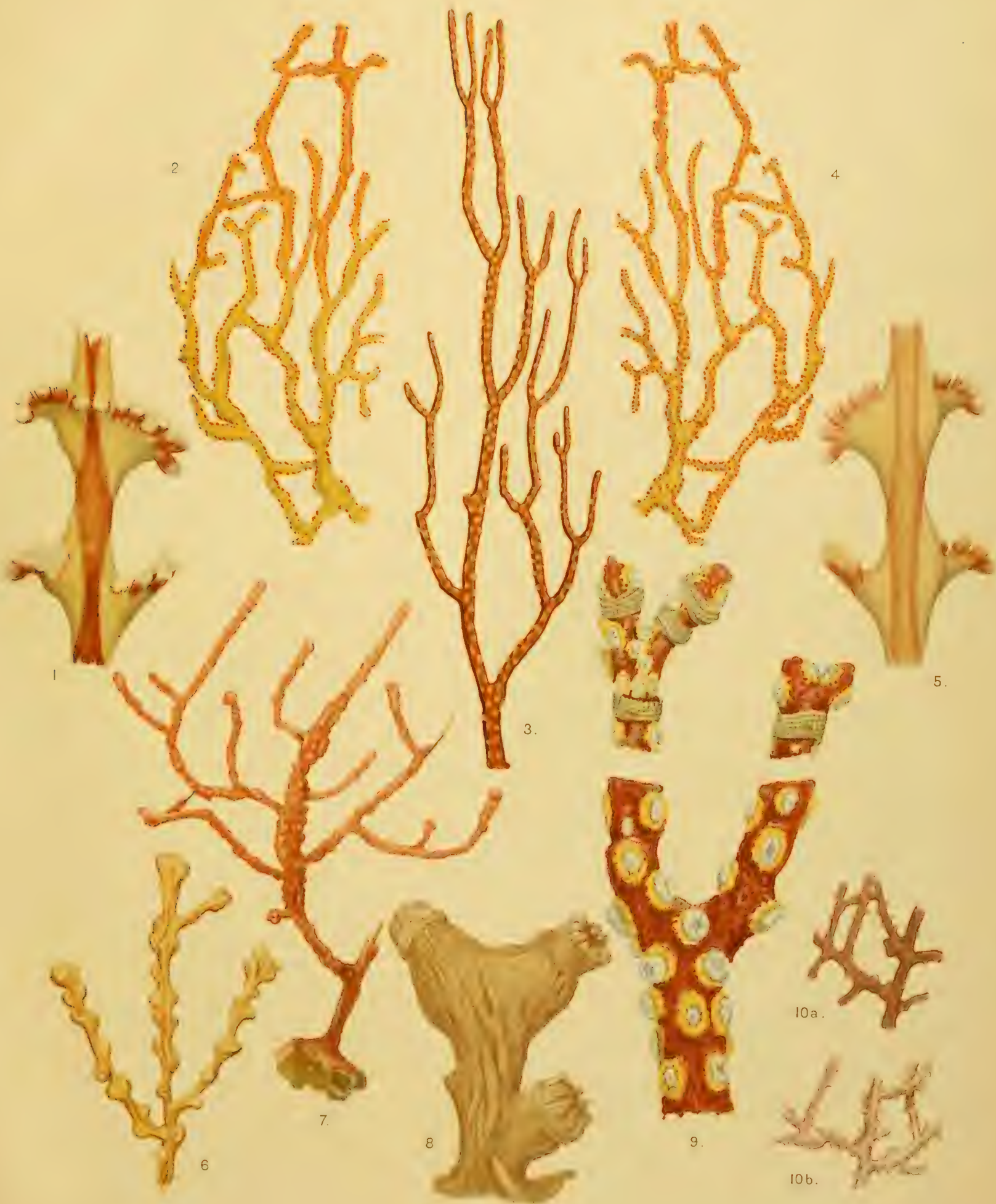
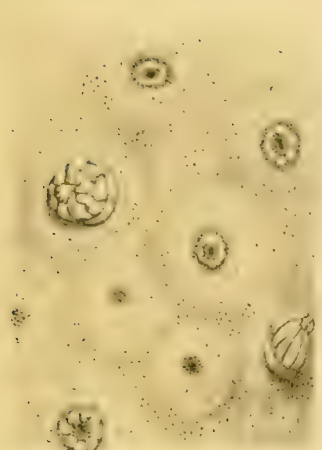
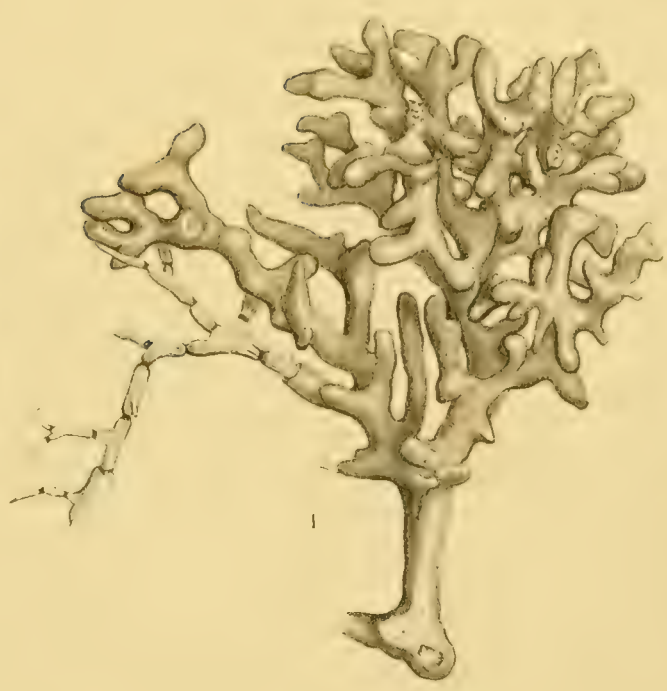


PLATE VI.

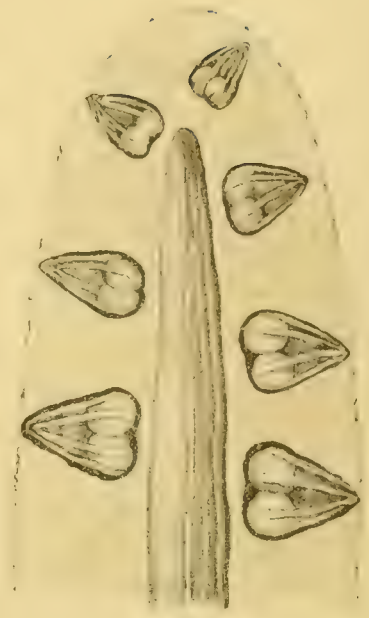
- Fig. 1. *Isis hippuris*, Linnæus. Colony (n.s.).
,, 2. ,, ,, ,, Section of tip of twig ($\times 10$).
,, 3. ,, ,, ,, Portion of surface of branch ($\times 14$).
,, 4. *Bebryce tenuis*, n. sp. Portion enlarged ($\times 7$).
,, 5. ,, ,, ,, Colony (n.s.).
,, 6. *Menacella gracilis*, n. sp. Portion enlarged ($\times 7$).
,, 7. *Lituarina hicksoni*, n. sp. Colony (n.s.).
,, 8. ,, ,, ,, Tip of colony enlarged ($\times 3$).
,, 9. *Pteroeides intermedium*, n. sp. Pinnule ($\times 5$).



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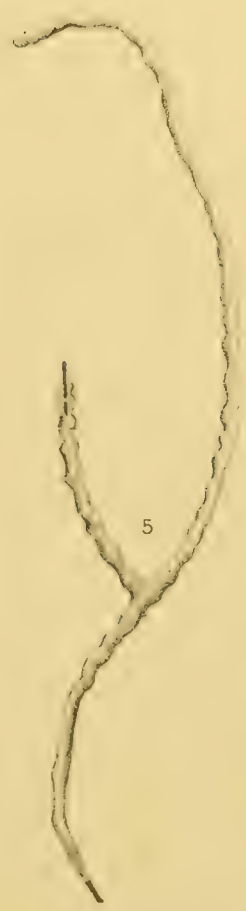
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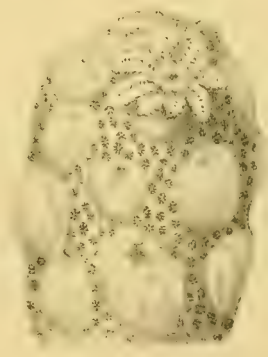
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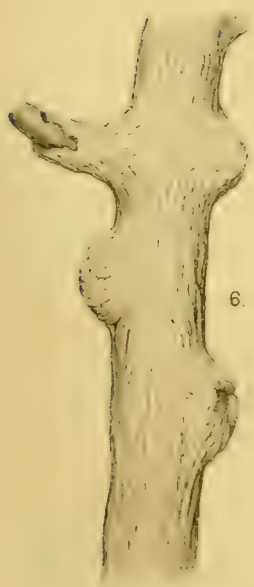
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8.



7.



6.



9.

PLATE VII.

- Fig. 1. *Cactogorgia celosioides*, Simpson. Complete colony ($\times 2$).
- „ 2. „ „ „ Polyp ($\times 10$).
- „ 3. (a) „ „ „ Spicules from the stem.
- „ 3. (b) „ „ „ Spicules from the anthocodiæ.
- „ 3. (c) „ „ „ Spicules from the aboral surface of
the tentacles.
- „ 4. *Cactogorgia alciformis*, Simpson. Complete colony ($\times 2$).
- „ 5. „ „ „ Polyp ($\times 10$).
- „ 6. (a) „ „ „ Spicules from the stem.
- „ 6. (b) „ „ „ Spicules from the anthocodiæ.
- „ 6. (c) „ „ „ Spicules from the aboral surface of
the tentacles.
- „ 7. *Cactogorgia expansa*, Simpson. Complete colony ($\times 1\frac{1}{4}$).
- „ 8. „ „ „ Polyp ($\times 10$).
- „ 9. (a) „ „ „ Spicules from the stem.
- „ 9. (b) „ „ „ Spicules from the anthocodiæ.
- „ 9. (c) „ „ „ Spicules from the aboral surface of
the tentacles.



1



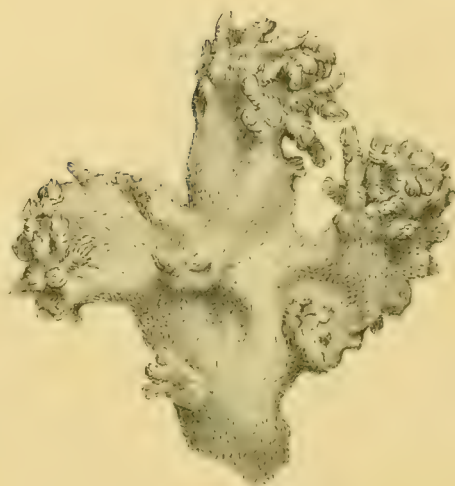
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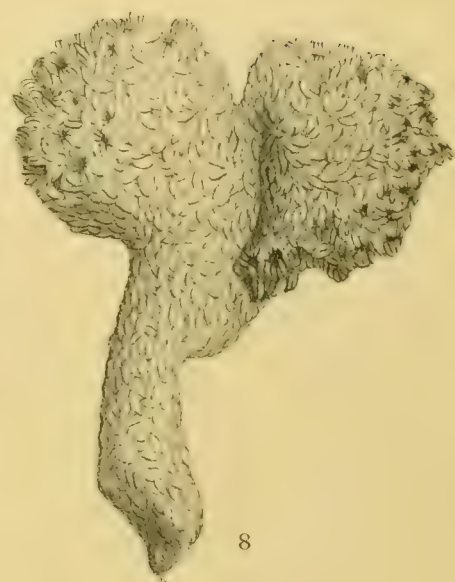
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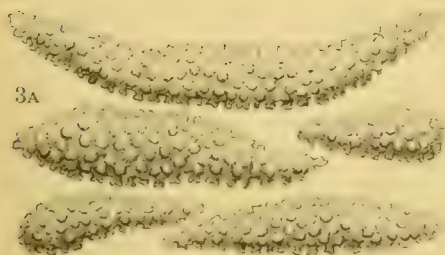
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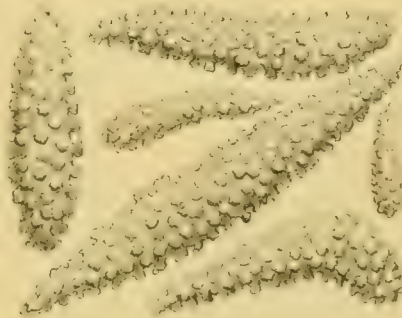
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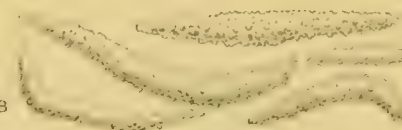
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9A



3B



6B



9B



3C



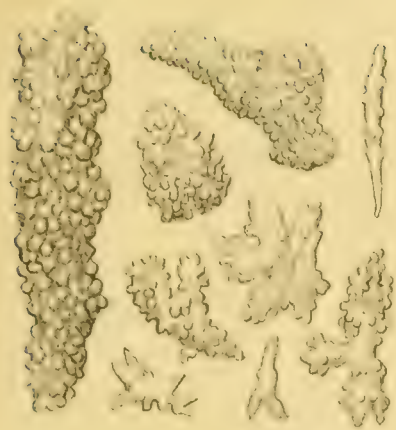
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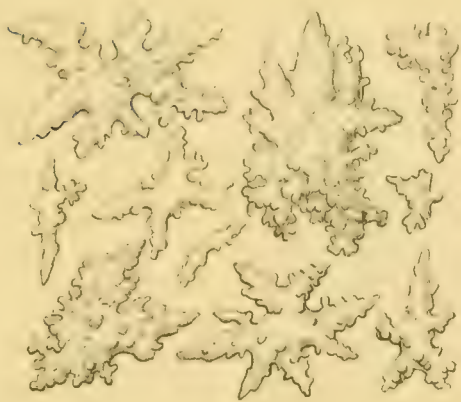
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PLATE VIII.

- Fig. 1. *Echinogorgia macrospiculata*, n. sp.
,, 2. *Echinomuricea andamanensis*, n. sp.
,, 3. *Echinogorgia ramulosa*, Gray.
,, 4. *Echinomuricea indica*, n. sp.
,, 5. *Echinogorgia intermedia*, Studer.
,, 6. *Echinomuricea reticulata*, n. sp.
,, 7. *Acamptogorgia tenuis*, n. sp.
,, 8. *Gorgonella umbella*, Esper.
,, 9. *Gorgonella granulata*, Esper.
,, 10. *Gorgonella umbella*, Esper.
,, 11. *Nicella pustulosa*, n. sp.
,, 12. *Nicella reticulata*, n. sp.
,, 13. [Inserted by mistake.]
,, 14. *Anthogorgia racemosa*, n. sp.
,, 15. *Eumuricea ramosa*, n. sp.
,, 16. *Menacella gracilis*, n. sp.
,, 17. *Eumuricea splendens*, n. sp.
,, 18. *Muricella arborea*, n. sp.



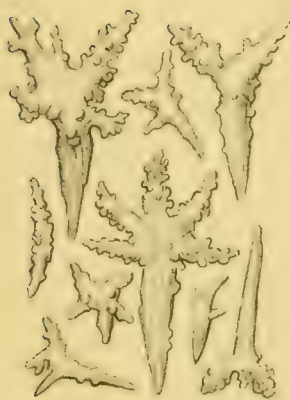
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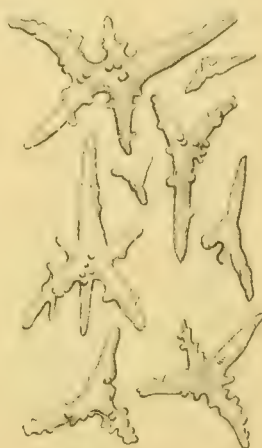
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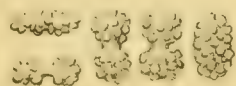
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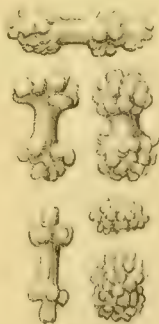
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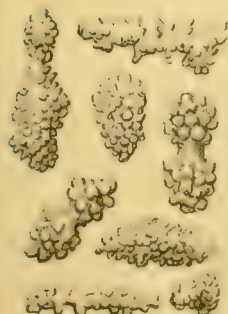
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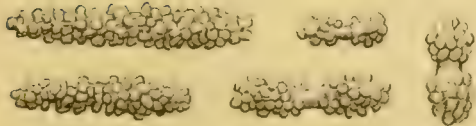
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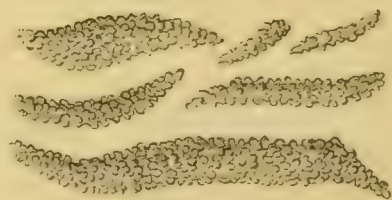
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16.



17.



18.

PLATE IX.

- Fig. 1. (a) *Cavernularia orientalis*, n. sp. Trunk.
 „ 1. (b) „ „ „ „ Stalk.
 „ 2. *Lituaria hicksoni*, n. sp.
 „ 3. *Cavernularia andamanensis*, n. sp. Trunk.
 „ 4. *Parabelemnion indicum*, n. gen. et sp.
 „ 5. (a) *Acis pustulata*, Wright and Studer. Main stem.
 „ 5. (b) „ „ „ „ „ Twig.
 „ 6. (a) *Acis ulex*, n. sp. Coenenchyma.
 „ 6. (b) „ „ „ Polyp.
 „ 6. (c) „ „ „ Twig.
 „ 7. (a) *Siphonogorgia media*, n. sp.
 „ 7. (b) „ „ „ „
 „ 8. *Siphonogorgia macrospina*, Whitelegge.
 „ 9. *Siphonogorgia intermedia*, Studer.
 „ 10. (a) *Psammogorgia ridleyi*, n. sp. Base.
 „ 10. (b) „ „ „ „ Twig.
 „ 11. *Melitodes ornata*, n. sp.
 „ 12. *Melitodes philippinensis*, Wright and Studer.
 „ 13. *Plexauroides praelonga* (= *Plexaura praelonga*, Ridley).
 „ 14. *Bebryce mollis*, de Philippi.
 „ 15. „ „ „ „





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